

Vol. XIX

No. 10

# DISSERTATION ABSTRACTS

*ABSTRACTS OF DISSERTATIONS AND  
MONOGRAPHS IN MICROFORM*

UNIVERSITY MICROFILMS, INC.  
ANN ARBOR, MICHIGAN: 1959





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## AGRICULTURE

### AGRICULTURE, GENERAL

#### ECONOMETRIC ANALYSIS OF THE DEMAND AND SUPPLY RELATIONSHIPS FOR LARD AT THE RETAIL LEVEL

(L. C. Card No. Mic 59-499)

Albert Estern Drake, Ph.D.  
University of Illinois, 1958

This investigation is directed toward the identification and evaluation of the causal factors behind the wide fluctuations in the price of lard over the past twenty-seven years by the limited-information, maximum-likelihood method of parameter estimation.

The higher complex nature of the fats and oils economy reflects the wide diversity of the many sources of supply and the large variety of uses to which these commodities are adaptable. The principal sources of domestic fat and oil supply are the slaughter animals, soybeans, cottonseed, milk, and beginning-year stocks; the principal outlets are the food and industrial sectors of the economy, the export market, and carry-over stocks.

Since lard is consumed largely as a food in the domestic economy, an economic model of the retail food market is constructed with some built-in connections to the wholesale market, the industrial sector, and the export market. Economic theory, a priori knowledge, available data, and--where necessary--appropriate assumptions are used as aids in the construction of the model. The equations represent the principal commodity of interest--lard, the substitute commodities--shortening and margarine, the complementary commodity--meat, other food commodities, and the industrial fats and oils.

Estimates of the nonzero parameters were obtained by the limited-information, single-equation method. The method itself was developed in a straightforward and simplified manner. Attendant proofs were given with close attention to the difficult manipulations.

The method did not, however, yield "sharp" estimates of the structural parameters. The coefficients lacked internal consistency in their cross-elasticities and did not differ significantly from zero in a large number of cases. The study has, therefore, limited applicability.

The principal causal factors behind the wide price fluctuations for lard were, however, clearly indicated. These factors are (1) changes in the level of supply of lard (or substitutes for lard) from one observation period to the next, (2) changes in the level of income, both in the short- and long-run periods, and (3) the factors associated with time.

Because of the lack of "sharp" estimates, there is some doubt that those people who deal in the commodity market will be better able to predict the impact of given changes in the market as a consequence of this study. Policy makers have, however, been provided sufficient information to show that the stabilization of the prices of fats and oils depends

largely on a stable level of domestic supplies which, in turn, implies a free movement of fats and oils in international trade.

The application of the limited-information, single-equation method of estimation to this problem answers in the affirmative the question of whether or not the structural relationships of minor commodities (like lard) can be ascertained from the available secondary data. This specific use implies that other and possibly more general uses are possible.

Microfilm \$2.65; Xerox \$9.20. 204 pages.

#### LABORATORY EXPERIMENTS WITH SOME ORGANIC PHOSPHORUS INSECTICIDES AS WHEAT PROTECTANTS

(L. C. Card No. Mic 59-973)

Krishnaji Shanker Gore, Ph.D.  
Cornell University, 1958

Experiments were designed to test and compare the efficacy of 5 organo-phosphorus insecticides against 2 major pests of stored products, namely rice weevil, Sitophilus oryza (L.) and confused flour beetle, Tribolium confusum, Duv. The 5 insecticides used were malathion, Diazinon, Dicapthon, Dipterex and Co-ral.

Dipterex and Co-ral formulations at all concentrations including the 0.250 per cent, were effective only up to a maximum period of 4 months. It was only at high concentrations that Dicapthon afforded protection for 4 months in both the series of experiments. But Dicapthon samples at higher concentrations spoiled.

Malathion at highest concentration of 0.250 per cent gave protection against both the pests for 6 months. Its efficacy against rice weevil was less than that of Diazinon, which was effective for 6 months at low concentration of 0.0313 per cent. It was only at the highest concentration of 0.250 per cent that both malathion and Diazinon were effective against confused flour beetle for a period of 6 months.

Residue analysis of those samples which remained effective for long periods was conducted. In absence of any reliable, available method, no residue analysis was conducted on samples treated with Dipterex and Co-ral. Both total and external residue analyses was run in each case.

The total residue in malathion treated wheat was below the level of tolerance (8 parts per million), allowed by the U. S. Food and Drug Administration.

Both external and total residues in case of Diazinon were highest than the other 2 insecticides. It is found to have more residual action than the rest of the insecticides.

The total residue present on wheat treated with Dicapthon increases with increased concentrations. It is greater in quantity than malathion. The ratio of total to external



residue ranged from 2.45 to 4.10 in malathion, from 1.70 to 6.70 in Diazinon and from 2.70 to 4.00 in case of Dicapthon. Microfilm \$2.00; Xerox \$4.60. 86 pages.

#### PARABIOSIS OF RATS OF TWO DIFFERENT AGES

(L. C. Card No. Mic 59-683)

Emily Mae Horrington, Ph.D.  
Cornell University, 1958

Parabiosis has been used as an experimental tool in various fields but little work has been done to specifically determine the reaction of albino rats to the state of parabiosis.

The purpose of this study was to determine the reactions of rats of two different ages when surgically joined in parabiosis.

Retarded and non-retarded rats were used. The retarded rats were restricted in calories so that younger rats from a later litter of the same dam could be joined with them. Retardation made it possible to have rats equal or nearly equal in size but of different ages.

The experiment included studies in growth and life span, dental caries, bone length, volume and density, blood pressure, blood counts and pathology.

It was found that the life span of the retarded rats did not appear to be shortened by parabiosis, while the life span of the non-retarded rats was slightly less than expected.

The mean maximum weight reached by the pairs (divided by 2) was not as great as that reported for the strain used. This difference may be a result of parabiosis.

It appears from the data that the group having the smallest mean difference in age had the longest life span.

No particular pattern or incidence of dental caries was found that could be called a result of the state of parabiosis.

The pathological findings were largely the same as those found in non-parabiosed rats. Some exceptions were: hydronephrosis, age of onset of periarteritis, bone density and blood counts.

Extreme cases of hydronephrosis were seen in four rats. The fact that an animal could survive with such an extensive lesion has been explained by the fact that in parabiosis the animal had the advantage of the functioning kidneys of its pairmate.

It has been reported for the strain used that periarteritis is usually seen after 750 days of age. Periarteritis in the parabiotic rats of this study was seen frequently and in more than 50% of the cases was found in rats less than 750 days of age.

No significant difference was found between the densities of the humeri from the old rats and their younger pairmates. The bone densities of both of a pair fell within the normal range of density reported for the humeri of non-retarded, non-parabiosed rats of this strain.

Blood pressure readings for the parabiotic rats were unstable with each member of a pair being, at times, hypertensive and hypotensive. Treatment with an adrenergic blocking agent abolished these fluctuations in pressure.

Blood counts showed that one member of a pair always had a reduced number of red blood cells as compared with

normal values. This did not occur in either member of the pair more frequently than in the other.

Microfilm \$2.00; Xerox \$4.00. 73 pages.

#### SEASONAL CHANGES IN THE RATES OF PHOTOSYNTHESIS AND RESPIRATION OF LOBLOLLY PINE AND WHITE PINE

(L. C. Card No. Mic 58-2741)

William H. Davis McGregor, Ph.D.  
Duke University, 1958

Supervisor: Paul J. Kramer

Seasonal trends in the rates of net photosynthesis and respiration of potted loblolly pine and white pine seedlings were studied by measuring CO<sub>2</sub> exchange with an infrared gas analyzer at intervals during the year. Seedlings remained out-of-doors except during measurements. All measurements were made indoors at 25° C, and photosynthesis was measured at 4,000 fc of light.

Beginning in February, the rate of photosynthesis of both species increased, reached a peak, and then declined rapidly. The maximum rate for loblolly pine seedlings was reached in mid-September and for white pine seedlings between July 15 and September 15. The increase began before new needles emerged, and the autumn decline was not accompanied by any appreciable loss of foliage.

The respiration rate of loblolly pine seedlings increased steadily throughout the year. Respiration of white pines increased as the plants were growing, decreased after growth ceased, and then increased again during the winter.

Stem elongation of white pine essentially was complete by May 15, but loblolly pine continued steady elongation until September 10.

Maximum efficiency of photosynthesis per unit of fascicle length was in July for white pine and in May for loblolly pine. Efficiency declined after September in both species. Respiration rate per unit of fascicle length showed a sudden marked increase early in April, coinciding with the initiation of spring growth. The rate then decreased to a minimum in September and increased during the winter for both species.

Total chlorophyll per seedling reached a maximum in September for both species and declined slightly during the winter. Total chlorophyll per unit of fascicle length increased in the spring, showed a slight midseason drop, and reached a second peak in September. Photosynthesis per unit of chlorophyll showed a maximum efficiency in May for loblolly pine and in July for white pine.

Changes in the rates of photosynthesis and respiration following sudden drastic alterations of environment were studied.

The effect of photoperiod on the rates of photosynthesis and respiration of loblolly pine from two geographic origins was studied. Georgia seedlings, on a per-seedling basis, were carrying on photosynthesis at a higher rate than were Florida seedlings, and the rate of photosynthesis of seedlings grown under long day was higher than that for seedlings grown under short day. These differences were accounted for by differences in total photosynthetic tissue,



however. It was concluded that the effect of long photo-period was to produce more photosynthetic tissue from a given amount of photosynthate, rather than to alter the basic rate of photosynthesis.

The rate of photosynthesis was found to remain constant for up to 16 hours at 30° C and 4,000 fc of light. Respiration was constant for 16 hours at 23° C in the dark.

At 4,000 fc of light, the optimum temperature for net photosynthesis of loblolly pine and white pine seedlings was between 20° and 25° C. Above 25° C the rate decreased much more rapidly in white pine than in loblolly pine. Respiration continued to increase beyond 40° C.

The C<sup>14</sup> labeled products of photosynthesis did not change with temperature, but increased in number with time.

An estimate of the total net accumulation of carbon over an entire year, based on the relationships revealed in this study, indicated that loblolly pine seedlings, although somewhat smaller initially, could accumulate twice as much carbon annually as white pine seedlings. The conclusion was that climatic conditions in the Durham area, particularly temperature, affect photosynthesis and respiration of white pine seedlings over the year in such a way as to reduce the net assimilation of carbon below the minimum necessary for successful competition or survival. This may be a major factor limiting the southern range of white pine.

Microfilm \$2.00; Xerox \$4.60. 89 pages.

#### THE EXTRACTION AND QUANTITATIVE ESTIMATION OF FREE AMINO ACIDS IN SOILS

(L. C. Card No. Mic 59-1287)

Eldor Alvin Paul, Ph.D.  
University of Minnesota, 1958

Methods for extraction of amino acids were studied to establish procedures for better characterization of the free amino acid fraction in soil. Experiments with arginine, leucine and aspartic acid added to soil demonstrated that extraction with ionic solutions such as barium hydroxide, followed by precipitation of the barium, was an effective and convenient procedure. The same amino acids were added individually to soils, and water, 0.1 N barium hydroxide, and 80% ethanol were compared as extracting agents. Successive elutions with ten 15-ml. fractions of extractant gave recoveries of 75 to 100 percent for barium hydroxide, while ethanol and water extracted lesser amounts of some of the amino acids. Addition of a mixture of 18 amino acids to soil was followed by barium hydroxide extraction after 1 hour. Analyses of the concentrated extract by elution chromatography gave recoveries of 73 to 121% for the acidic and neutral and 36 to 41% for the basic amino acids.

An ammonium acetate extraction procedure was then developed to avoid possible hydrolysis of amino acid polymers in the soil. The amino acids were displaced from the soil with 0.5 N pH 6.8 ammonium acetate. After evaporation, the ammonium acetate was removed by sublimation. The amino acids were extracted from the remaining extraneous salts with ethanol and determined by gradient elution chromatography. Tryptophan showed somewhat high recoveries. The 17 other amino acids ranged from 31 to 83% with an average of approximately 60%.

The quantities of naturally occurring free amino acids extracted from soil by the ammonium acetate extraction technique were similar to those found with barium hydroxide. Analyses of free amino acids in an ammonium acetate extract of unamended soils indicated 20 to 25 amino compounds detectable in concentration of 0.05 to 0.5 ug. per g. of soil. Increasing the microbial activity of the soil by amendment with 1% glucose and 0.3% potassium nitrate resulted in the production of 40 different amino compounds. The following were identified by relative position on the gradient elution chromatograph, paper chromatography, and specific spot tests: cysteic acid, aspartic acid, methionine sulfoxide, hydroxyproline, serine, threonine, proline, glutamic acid, glycine, alanine, valine, cystine, methionine, isoleucine, leucine, beta alanine, tyrosine, beta amino isobutyric acid, lysine, histidine and arginine. Phosphoserine, taurine, cystathionine, diaminopimelic acid, ornithine and ethanolamine were tentatively identified and 8 other unknowns were detected. The majority of the amino acids ranged from 1 to 5 ug. per g. but glutamic acid, alanine, isoleucine, leucine and the tyrosine, beta amino isobutyric acid peaks often ranged in concentration from 10 to 37 ug. per g. of soil. The total free amino acid content of rhizosphere and non rhizosphere soils did not differ greatly.

Determination of the changes in the occurrence of amino acids with prolonged incubation indicated that incubation of amended soils beyond 3 days - at which time the amino compounds were approximately 40 times as concentrated as in the control - resulted in a gradual drop in concentration of amino compounds until at 14 days the majority of the amino compounds were present at only 4 times the concentration found in the zero control. Glutamic acid did not follow this trend; it increased in concentration until after 5 days incubation, and after 14 days was still present at a concentration of 3.98 ug. 20 times that found in the control sample.

Microfilm \$2.00; Xerox \$4.40. 85 pages.

#### STUDIES ON THE ABSORPTION AND TRANSLOCATION OF DALAPON IN NORTHERN NUTGRASS (*CYPERUS ESCULENTUS* L.)

(L. C. Card No. Mic 59-694)

Walter John Saidak, Ph.D.  
Cornell University, 1958

This study was an attempt to solve the problem of variability obtained in northern nutgrass control using the herbicide dalapon. It was hypothesized that an investigation of dalapon translocation in the plant could possibly provide an answer.

Radioactive dalapon (2,2-(dichloropropionic)acid-2-carbon 14) was used as a tracer in conjunction with commercial dalapon in this study. Assays for tracer distribution in the plant were made employing a windowless flow counter for a direct counting procedure. Plant samples were prepared for counting by obtaining homogenates which were then centrifuged to precipitate solid material. Radioactivity was then determined using the resulting supernatant liquids.

Basipetal dalapon translocation within mature leaves of nutgrass and quackgrass was found to be similar. This downward movement was inhibited by concentrations which produced a rapid necrotic effect.



Three weeks old nutgrass plants grown on a 10 ppm. labeled dalapon solution transported the bulk of this material to the leaves. An average of two percent of the total applied dalapon was recovered in the tubers on each sampling date. The average recovery in the roots was about three percent.

Identical distribution patterns in the plants were obtained from dalapon treatments applied to the soil or in solution culture. Negligible recoveries were made from the roots and tubers with high recoveries being made from the leaves. High rates of dalapon had a depressing action on the amount of dalapon moved upwards.

Little dalapon movement out of a mature leaf was observed when the entire leaf received a dip treatment into a dalapon solution. This suggests that basipetal movement of dalapon out of a leaf is prevented by some translocatory block in the basal area of the leaf since earlier studies indicated the process does take place from the leaf apex to the leaf base. The mechanism responsible for the small quantity of dalapon moved out of a leaf is inhibited by high rates of dalapon.

The net result that dalapon absorbed by roots or leaves is not translocated to the parent tuber to any appreciable extent indicates that differences in the extent of dalapon translocation to the parent tuber of the plant is not the main reason for erratic field control.

Microfilm \$2.00; Xerox \$4.20. 79 pages.

#### ECONOMIC EFFECTS OF BULK MILK HANDLING

(L. C. Card No. Mic 59-591)

Martin Veikko Waananen, Ph.D.  
University of Illinois, 1958

Farm bulk-tank handling of milk is a major development in milk transportation and can be expected to have many economic effects on the dairy industry of the United States. Bulk milk handling was first introduced in the early 1940's on large dairy farms. In the early 1950's this new method was adopted on thousands of dairy farms of various sizes throughout the United States.

The purpose of this study was to analyze some of the economic impacts of bulk tank handling of milk from farmer to processor.

The theory of transportation and past developments in milk transportation indicate that improvements in transportation can be expected to result in an expansion of supply areas. The milk supply area for Seattle, which was selected as the area for study, has expanded but the influence of various geographic and institutional factors were sufficiently strong to cloud the influence of bulk handling. The study did reveal that a larger proportion of milk moves directly from farms to city plants, by-passing the country receiving stations.

Within the limits of the analysis the results of this study failed to support the idea that bulk tank handling on farms results in a reduced seasonality of milk production. The change in seasonality indexes (May milk deliveries as a percentage of November milk deliveries) from 1952 to 1955 among can and tank shippers in the Puget Sound area of Washington were not significantly different.

The increase in production of milk was found to be sig-

nificantly greater on farms using bulk tanks. During a three-year period producers in the Seattle area who continued to ship milk in cans increased their May plus November milk deliveries an average of 20 per cent compared to an average of 34 per cent for producers using bulk tanks. However, the pattern of increases suggests that increased production by bulk tank users is not continuous but is a change made shortly after the bulk tank came into use.

New methods of charging producers for hauling milk have developed in some areas of Washington as a result of changes in relative costs of hauling bulk milk. Three methods of determining rates were developed in this study. The methods concern rate structure only and not the level of rates. Criteria for selecting among these methods were not developed.

Some of the bulk tank financing methods used in the Seattle, Washington and Chicago and Danville, Illinois markets were described. These methods had many important aspects in common. The credit was productive, yielded a high rate of return, involved low risk, and did not curtail credit available for other uses. In considering financing, the farmer probably did some careful planning about his future operations.

A survey of fourteen federal order markets in the United States was used as a basis for estimating costs in the transportation of milk in bulk tanks as compared with those in cans. This showed potential savings of 31 million dollars in costs with bulk handling. The savings in the markets studied averaged 5.3 cents per hundredweight, assuming an all-tank or all-can operation. The savings in individual markets ranged from 0.7 to 18.5 cents per hundredweight. Microfilm \$2.90; Xerox \$10.00. 224 pages.

#### AGRICULTURE, ANIMAL CULTURE

##### THE EFFECT OF CONSTANT AND ALTERNATING TEMPERATURES AND VARIOUS RELATIVE HUMIDITIES ON GROWTH, SURVIVAL AND REPRODUCTION OF TRIBOLIUM CONFUSUM DUVAL

(L. C. Card No. Mic 59-604)

Mohammed A. Al-Rawy, Ph.D.  
University of Minnesota, 1958

As a result of a study made by Al-Rawy (1956), following a lead by Lin, Hodson, and Richards (1954), an On-copeltus fasciatus (Dallas), the present investigation was carried out as a continuation of these investigations. It was found with O. fasciatus that survival of hatched nymphs was not proportional to hatching success under certain conditions of temperature and moisture when the hatched nymphs were transferred to optimal conditions. And the so-called "delayed-effect" was very prominent. Thus, experiments comparable to those with O. fasciatus were performed on Tribolium confusum Duval, to determine whether or not those findings apply to another insect species.

The effect of various combinations of temperature-moisture on the different stages as well as on the whole life cycle, and the effect of various lengths of exposure of



eggs to low temperatures was studied. Furthermore, adults effected by those environmental conditions at some immature stage were tested for egg production and for hatching of their eggs. Egg hatching of *T. confusum* occurred between 17 and 38° C. and at relative humidities from 0 to 100%. But the optimal conditions were between 20 and 35° C. and from 0 to at least 75% R.H. The whole life cycle was completed at constant temperatures of 20 to 38° C. and 75% R.H. with an optimum between 25 and 35° C. The "delayed-effect" was not found to be of any significant importance with *T. confusum* when any of the egg, larval or pupal stage was investigated over a wide range of temperature and relative humidity. It was only extremes of these conditions and longer exposure to these extremes that showed a significant delayed-effect on later stages when these were held at optimal conditions. The adult stage may be reached at least by some individuals regardless of how few eggs hatch and the severity of the incubation conditions, if the hatched individuals are transferred to optimal conditions after hatching. This is contrary to results obtained with *O. fasciatus* eggs which may hatch well at some conditions far from the optimum. Yet when the hatched nymphs are transferred to optimal survival conditions the nymphs fail to transform even to the second nymphal instar. Accordingly, what has been found with *O. fasciatus* does not apply to all other insects.

As far as the productivity of adults and hatching of their eggs is concerned, extreme conditions may affect either one or both, depending on the exposed stage or stages and on the period of exposure. When the eggs were exposed during all or part of the incubation period to these extremes usually only productivity was influenced. Larval exposure to low temperatures affected both egg production and egg hatching. Pupal exposure to low and high temperatures caused a certain degree of sterility to both males and females, while temporary sterility resulted from the high temperature, it was permanent after exposure to low temperatures. Temperatures of 20 and 38° C. as rearing conditions influenced both egg production and egg hatching in the surviving adults.

These results emphasize the importance of the "delayed action" of environmental factors, which if ignored will make evaluation of the effect of the environment misleading. Microfilm \$3.15; Xerox \$10.80. 244 pages.

#### THE EFFECT OF THE DIETARY RATIO OF HAY TO CONCENTRATE ON EFFICIENCY OF ENERGY UTILIZATION FOR MILK PRODUCTION

(L. C. Card No. Mic 59-678)

John Murray Elliot, Ph.D.  
Cornell University, 1958

Lactation and balance studies, involving 12 high-producing Holstein cows in a randomized complete block design, were carried out to compare the efficiency with which digestible energy (DE) was utilized for milk production when concentrates supplied 40, 60 or 80 percent of the estimated net energy (ENE) intake. Second-cutting alfalfa hay was used as the roughage. All animals received the same ENE allowance above their maintenance requirements, and the level of feeding was held constant. The experimental

period, which began between 6 and 7 weeks postpartum, was 14 weeks in length. The digestibility of the rations and the magnitude of urinary energy losses were determined on the same animals during the course of the lactation study. Ten dry cows were utilized to obtain comparable data on the hay alone. The relative distributions of the rumen volatile fatty acids were determined in rumen samples collected immediately following the balance trials and again approximately 4 to 6 weeks later.

There were no significant differences among treatments in production of 4 percent fat corrected milk (FCM). As concentrate supplied an increasing proportion of the ENE in the ration, however, the efficiency with which DE was utilized for FCM production increased in a rectilinear manner. As the proportion of concentrates in the ration increased, the apparent digestion coefficients for dry matter, ether extract, nitrogen free extract and gross energy, and the TDN values increased, while those for crude protein and crude fiber were not significantly affected. The digestion coefficients for gross energy were highly correlated with those for dry matter and with the TDN values. Urinary energy losses (expressed as percent of DE) decreased with increasing proportions of concentrate, but the urine calorie-nitrogen ratios were not significantly different among treatments.

The relative proportions of acetic, propionic and butyric acids in the rumen liquor were significantly different among treatments. Both the relative proportion of propionic acid, and the ratio of acetate to propionate were closely correlated with production efficiency. Regression equations relating these variables are presented, and the possibility of a causal relationship is discussed.

Microfilm \$2.00; Xerox \$5.60. 112 pages.

#### THE PHOSPHORUS REQUIREMENT AND THE COMPARATIVE VALUE OF SIX PHOSPHORUS SUPPLEMENTS FOR THE GROWING PIG FED SEMI-PURIFIED DIETS

(L. C. Card No. Mic 58-3166)

Charles Edwin Jordan, Ph.D.  
Purdue University, 1958

Major Professor: M. P. Plumlee

This study consisted of four experiments, three of which were concerned with the availability of the phosphorus from different supplements and the fourth with the phosphorus requirement of growing swine. Semi-purified diets were used in all studies; beef blood fibrin served as the protein source. This permitted an extremely low phosphorus basal diet (0.033 percent), thus when the supplemental phosphorus source was added, 88 to 89 percent of the total phosphorus was supplied by the test supplement in the availability studies. A minimal adequate total phosphorus level was employed to insure maximum utilization of the phosphorus in the experimental diets. Evaluation criteria used were: growth rate, feed consumption, feed efficiency, blood serum inorganic phosphorus determinations, femur ash and fluorine content and visual observations. Duroc pigs initially 6 to 8 weeks of age were used for 6 to 10 week feeding trials. All pigs were individually self-fed in



indoor concrete-floored pens. Six pigs per treatment were used in all trials.

The first experiment was a comparative study between U. S. P. grade dicalcium phosphate, commercial monocalcium phosphate and soft phosphate with colloidal clay. Feeding "soft phosphate" reduced growth rate significantly in comparison with pigs fed dicalcium phosphate, and also increased the feed required per pound of gain. Serum inorganic phosphorus levels in the "soft phosphate" group were also significantly lower than in the dicalcium phosphate lot. Commercial monocalcium phosphate was equal to dicalcium phosphate during the first 6 weeks of the 8-week experimental period, but fell slightly behind the last 2 weeks. Deficiency symptoms began to appear in all lots during the fourth week on treatment. As the experiment progressed the symptoms became more severe in the "soft phosphate" group. Even though this group continued to gain in weight, skeletal growth appeared to be almost at a standstill near the end of the feeding period.

The second experiment was a repeat and expansion of the first trial. Pigs fed for a 56-day period and started at approximately 26 pounds utilized the phosphorus in U.S. P. grade dicalcium phosphate and commercial monocalcium phosphate equally well with steamed bone meal next in order, then Curacao Island phosphate and soft phosphate with colloidal clay the poorest. There was a highly significant reduction in serum inorganic phosphorus in both the "soft phosphate" and Curacao groups. Average daily gain and average daily feed were highly significantly reduced and feed per pound of gain was highly significantly increased in the lot fed "soft phosphate" when compared with the group fed dicalcium phosphate. Three pigs in the "soft phosphate" lot (none of which recovered) and one in the Curacao lot (which did recover) collapsed in the rear legs due to a severe phosphorus deficiency during the trial. Bone ash data revealed a highly significant lowering in the "soft phosphate" treatment. The addition of calcium fluoride to supply the same fluorine level as was present in the "soft phosphate" ration (373 p.p.m.) did not affect performance in any way measured. Definite leg weaknesses began to appear in the "soft phosphate" and Curacao groups during the second week on treatment. These leg weaknesses, reduction in growth rate and in serum inorganic phosphorus levels appeared too early in the trials and were too closely correlated to have been from excessive fluorine, even though the level used was well above the safe levels recommended by the National Research Council. Over three times as much fluorine was deposited in the femurs from feeding "soft phosphate" than from feeding the same level of fluorine as calcium fluoride. It would seem that much of the fluorine in "soft phosphate" is in a form more easily absorbed than calcium fluoride. The data also indicates this is true of the fluorine in Curacao Island phosphate.

The pigs fed steamed bone meal were intermediate in general appearance. Even though gains, feed and blood data was comparable with that of the pigs fed dicalcium phosphate, this group showed more severe leg and pastern weaknesses.

An attempt to correct crooked legs developed during the 8-week trial was unsuccessful after an additional 14 weeks feeding period on different rations adequate in phosphorus.

Experiment 3 was a comparison of U. S. P. grade dicalcium phosphate and 85 percent Analytical Reagent grade phosphoric acid diluted to 75 percent with distilled water.

The phosphoric acid-fed group did slightly better (although not significantly) throughout in both growth rate and general appearance. It appeared that the diets containing phosphoric acid were more palatable than those containing dicalcium phosphate as evidenced by a very marked increase in feed consumption the first two weeks of the 10-week trial. Blood serum inorganic phosphorus values were more uniform throughout the feeding period in the phosphoric acid group than in the dicalcium phosphate group, however, at the end of the 70-day period, both groups were comparable.

A fourth trial was conducted to determine the optimum phosphorus level for pigs fed a semi-purified diet. Levels of 0.20, 0.30, 0.40, 0.50 and 0.60 percent phosphorus were fed. Six-week old pigs weighing approximately 20 pounds and continued for a 6-week period to approximately 70 pounds in weight were used. The results indicated that 0.30 percent phosphorus was the borderline requirement and that 0.40 percent was adequate for maximum growth, feed consumption, feed efficiency and normal serum inorganic phosphorus levels. Phosphoric acid was used as the source of phosphorus in this trial. The calcium content was maintained at a constant level thus the calcium to phosphorus ratio varied throughout the lots. Expressed as the amount of phosphorus required per day, these results indicated 4.4 grams to be adequate. It is important in interpreting the results of Experiment 4 to remember that the phosphorus supplied by phosphoric acid is more available to swine than is the phosphorus from supplements in common use in swine rations today.

Microfilm \$2.00; Xerox \$7.20. 151 pages.

#### A STUDY OF VITAMIN E DEFICIENCY IN PIGS FED A TORULA YEAST DIET

(L. C. Card No. Mic 59-1290)

Livia Pellegrini, Ph.D.  
University of Minnesota, 1958

The effects of feeding a vitamin-E deficient diet in which Torula yeast was the principal source of protein were studied in an attempt to characterize the manifestations of vitamin E deficiency in growing pigs. The effectiveness of alpha-tocopheryl acetate, sodium selenite and L-cystine supplementation in preventing the deficiency symptoms was compared.

A fatal liver necrosis developed in growing pigs fed the basal diet. L-cystine supplementation prevented liver necrosis, but not muscle degeneration and death. Mortality in these two groups was 100 per cent and the incidence was highest between the 50th and 70th day of the experimental feeding period.

Alpha-tocopheryl acetate at a level of 50 mg/lb of diet and sodium selenite at a level of 0.045 ppm, prevented death and gross or microscopic degeneration of liver and skeletal muscles.

Rate of gain and feed efficiency was comparable for the animals in all groups in the same experiment.

Reproductive performance of the gilts in Experiment I was quite unsatisfactory. Performance was complicated by illness of the experimental gilts and hence valid conclusions could not be drawn as to the adequacy of the basal diet supplemented with d-alpha-tocopheryl acetate.



Hemoglobin and hematocrit levels were maintained within the normal range in all subjects, during the trials.

No significant variation was noted in the serum tocopherol levels of pigs in the first experiment, while a significant difference between the d-alpha-tocopheryl acetate supplemented and unsupplemented pigs was observed in the second experiment. A slight decline in serum tocopherol values for the unsupplemented animals was noted but did not reach significance within the duration of the trials.

Urinary excretion of creatine and creatinine were measured in the pigs in the second experiment. While creatinuria of comparable magnitude was present in all animals of all groups up to four weeks of the experiment, it became more pronounced for the animals of the basal (Diet A) or basal plus L-cystine diets in the following weeks. Creatinine excretion did not vary significantly among animals and between groups and showed an average value of 30 mg/Kg/day/animal.

Microscopic study of the tissues revealed the pathology of the deficient animals to be mostly localized in the liver and in the skeletal muscles and heart. The histopathological picture of the liver was similar to that observed by others in rats fed similar diets (Torula yeast diets) and that of the skeletal and heart muscles closely resembled the one seen in guinea pigs, rabbits and rats fed a variety of diets having in common however the property of being vitamin-E free.

Microfilm \$2.00; Xerox \$5.20. 105 pages.

#### AGRICULTURE, FORESTRY AND WILDLIFE

##### SEASONAL CHANGES IN THE RATES OF PHOTOSYNTHESIS AND RESPIRATION OF LOBLOLLY PINE AND WHITE PINE

(L. C. Card No. Mic 58-2741)

William H. Davis McGregor, Ph.D.  
Duke University, 1958

A 2nd listing. Please see page 2418 for abstract.  
Microfilm \$2.00; Xerox \$4.60. 89 pages.

#### AGRICULTURE, PLANT CULTURE

##### FACTORS CONTRIBUTING TO EARLINESS IN TOMATO BREEDING, WITH SPECIAL REFERENCE TO ABILITY TO SET FRUIT AT LOW TEMPERATURES

(L. C. Card No. Mic 59-972)

Hugh Alexander Daubeney, Ph.D.  
Cornell University, 1958

This investigation was undertaken to compare some varieties as sources of earliness in tomato breeding. The

factors contributing to earliness, with special reference to the ability to set fruit at low temperatures, were studied in these varieties. A plant breeding program was initiated to incorporate any desirable earliness characteristics from one of these varieties, Puck, into some commercial varieties and to obtain preliminary information on the inheritance of these characteristics. Finally, a study was made of the methods used for selecting plants with earliness in segregating populations.

Data from field trials, conducted in three years at Ithaca, N. Y., revealed that the varieties Puck, Fireball, and Red Cloud and the Cornell breeding lines 54-149 and 54-179 each showed early flowering, early fruit set, and early ripening of fruit. Furthermore, these and several more varieties were found to set fruit at night temperatures lower than those reported in the literature as limiting to fruit set in most commercial varieties.

Earliness characteristics of Puck showed a dominant inheritance in the F<sub>1</sub> and F<sub>2</sub> progenies of the variety crossed with the later varieties Earliana, John Baer, or Rutgers.

Varietal differences in pollen germination and stylar elongation were found at low temperatures and both of these factors were considered to have some effect on fruit set. Viable pollen production at low temperatures in the field was abundant for all the varieties studied and it was concluded that this was not a factor limiting fruit set.

The most efficient method for selecting early segregants was found to be the conventional one based on early flowering. Microfilm \$2.00; Xerox \$4.40. 84 pages.

##### THE NITROGEN RELEASE OF VEGETABLE CROP RESIDUES DURING INCUBATION AS RELATED TO THEIR CHEMICAL COMPOSITION

(L. C. Card No. Mic 59-527)

Willy Masao Iritani, Ph.D.  
University of Illinois, 1958

The purpose of this study was to establish a criterion by which predictions can be made of the nitrogen available to growing plants from the decomposition of relatively fresh vegetable residues incorporated in the soil. Eleven residues were chemically analyzed for total nitrogen, water soluble nitrogen, total carbon and lignaceous carbon. These residues were incubated in soil under controlled conditions of temperature, aeration and moisture for four weeks. The incubation was carried out by the use of three different methods; the constant air flow method in which a small amount of CO<sub>2</sub> free air was continuously passed through the soil samples and the CO<sub>2</sub> given off from the decomposition process quantitatively analyzed, a flask method in which the flasks containing the soil samples were stoppered and aerated twice a week, and a pot method in which the nitrogen release was measured by the amount of uptake in tomato plants. The accumulation of mineral nitrogen by these methods of incubation was determined and the results correlated with the chemical composition of the residues.

Analyses of the amount of mineral nitrogen accumulated from the various residues showed that the three methods were not significantly different. However, there were two instances in which the agreement was poor in comparison



to the other two methods. One was the release from the check soil of the flask method which was unusually high and the other was the low amount of nitrogen obtained from corn residues in the pot experiment. These low amounts from the pots suggest that some factor associated with the decomposition of corn residues was inhibiting the uptake of nitrogen by the tomato plants.

Ammonia accumulation was quite high and variable. This might be explained by partial sterilization caused by air drying of the soil which is known to affect the nitrifying organisms.

Multiple and simple correlation and regression analyses between the chemical composition of the residues and nitrogen release revealed that the nitrogen content of the residues was the primary factor influencing the accumulation of mineral nitrogen. Water soluble nitrogen was shown to be twice as effective as the insoluble fraction in affecting nitrogen release. A multiple correlation using both total and water soluble nitrogen was significantly better than any of the other correlations for predicting nitrogen release. A minimum of approximately 1.66 to 1.89% nitrogen content in the residues was required before any accumulation of mineral nitrogen over that produced by the soil alone could be expected.

Carbon played an insignificant role in affecting nitrogen release. This might be explained by the fact that lignin was not present in large enough amounts to create measurable effects and also by the fact that there was not much variation among the residues in the amount of nonlignaceous carbon present. The C/N ratio proved to be a relatively poor criterion for the prediction of nitrogen release. The plot of the ratio with nitrogen release gave a curvilinear regression line. The dividing line between positive and negative release of nitrogen was a ratio of approximately 20:1.

In the constant air flow method the information of CO<sub>2</sub> release was better correlated with nitrogen release than carbon content of the residues. The dry matter accumulation of tomato plants in the pot experiment was highly associated with nitrogen availability.

Microfilm \$2.00; Xerox \$3.00. 52 pages.

#### STUDY ON THE RESISTANCE IN ALFALFA TO COMMON LEAF SPOT AND ON THE RELATION OF INFECTION RATING TO PLANT COLOR

(L. C. Card No. Mic 59-1279)

Zvi Karchi, Ph.D.

University of Minnesota, 1958

Adviser: W. M. Myers

Two resistant and two susceptible clones were used as parents of crosses and as tester parents. The 26 F<sub>1</sub> clones from the three crosses between them (resistant x resistant, resistant x susceptible and susceptible x susceptible) were used in this study.

Self and cross fertility values were measured in terms of seeds produced per flower tripped. Seed yields from selfing were lower than those resulting from crossing the F<sub>1</sub> clones with each of the four testers. When the non-parental tester clones were used as males on the F<sub>1</sub> clones the resulting seed yields were higher than those obtained when the parental clones were used as male testers.

The F<sub>1</sub> clones, their F<sub>2</sub> progenies, and the progenies of each F<sub>1</sub> clone from crosses with the two resistant and the two susceptible testers were studied for their reaction to common leaf spot.

Those F<sub>1</sub> plants classified as resistant on the basis of their clonal reaction segregated with a preponderance of resistant plants in the F<sub>2</sub>. However, two or three groups were distinguishable among the resistant F<sub>1</sub> clones on the basis of the progeny performance from their test crosses with the susceptible testers. In all crosses of F<sub>1</sub> clones with the resistant testers progenies were equal in resistance or more resistant than the F<sub>2</sub> progenies of the same F<sub>1</sub> clones or than progenies of F<sub>1</sub> clones from crosses with the susceptible testers.

F<sub>1</sub> plants classified as susceptible on the basis of their clonal reaction segregated in the F<sub>2</sub> with a preponderance of susceptible plants. In each case progenies from F<sub>1</sub> clones crossed with the susceptible testers were equal in susceptibility or more susceptible than the F<sub>2</sub> progenies of the same F<sub>1</sub> clones.

The evidence suggested that the levels of resistance of the F<sub>1</sub> clones in crosses with the two kinds of testers determined the levels of resistance of the progenies. Highly significant positive correlations were obtained between mean leaf spot reaction of clones and the means of F<sub>2</sub>'s ( $r = .9436^{**}$ ), between clones and their progenies from crosses with susceptible testers ( $r = .9133^{**}$ ), and between clones and their progenies from crosses with the resistant testers ( $r = .8854^{**}$ ). In the latter case evidence indicated that these crosses were useful in evaluating the clones for common leaf spot only when a wide range of means were compared.

In crosses between resistant and susceptible plants, the progeny mean was mostly close to the mid-point but always between the parental mid-point and the mean of the resistant parent indicating partial dominance of resistance.

Results based on the average performance of test cross progenies reveals an additive trend towards greater susceptibility of the progenies with the lower levels of resistance of the parents.

In general, there is a satisfactory fit of the data to a monohybrid tetrasomic model assuming chromosome segregation. According to the model, quadruplex, triplex and duplex genotypes result in resistance and simplex and nulliplex in susceptibility. Before this model may be considered conclusive, studies based on larger progenies of test crosses with susceptible male testers and on F<sub>3</sub> progenies seem warranted.

Investigation of the relationship between infection rating and color intensity indicated that the environmental conditions were largely different in individual field replicates. These conditions resulted in correlations between the two characters that were low, negative but significant indicating a slight tendency of resistant plants to be lighter in color. There was no evidence to indicate that infection rating and color intensity were inherently associated.

Microfilm \$2.00; Xerox \$5.00. 98 pages.



**SOME PLANT CHARACTERISTICS AFFECTING  
YIELD IN DWARF BROOMCORN**

(L. C. Card No. Mic 58-5456)

Billy Alexander Melton, Jr., Ph.D.  
University of Illinois, 1958

Yield is a complex character. It is the end result and the sum of the activities of the plant acting within its genetic limitations in a given environment. Because of the complex nature of yield, it is often studied by separating it into its component parts. A knowledge of the associations of these components are of great importance in determining a rapid and efficient solution to plant breeding problems. Very little information of this type is available with reference to dwarf broomcorn and for that reason this study was conducted.

Five dwarf broomcorn varieties representing the widest range in yield and plant type available were studied in 1956 and 1957 at three space intervals. Morphological and developmental notes were taken during the growing season as needed and the data concerning yield, and the various yield components were taken at harvest on the main stems and tillers.

An analysis of variance indicated that significant differences in yield existed between the varieties in 1956 and 1957. In 1956 there were no significant differences in yield produced by the spacing treatments, but in 1957 the wider spacings yielded significantly less than the 3 inch spacing, but this decrease was not proportional to plant number.

There were significant differences in number of heads per plant between the varieties, but these differences became apparent only at the wider spacings. It was concluded that tiller number does not have a simple genetic basis, but is conditioned by many genetic and environmental factors.

At the three inch spacing the plants without tillers were the most important yield units, but at the wider spacings, the contributions of the multiheaded plants became more important and often approached 100 percent. The contributions of the tillers alone approached or exceeded 50 percent in many of the varieties at the 12 and 24 inch spacings.

On a single plant basis yield increased with an increase in the number of heads per plant despite a decrease in average head weight, head length, peduncle diameter, fiber diameter, stalk diameter, leaf length and leaf width. An increase in space per plant increased the size of these measurements on the main stem, but they decreased from the main stem through the successive tillers. An increase in the number of tillers per plant, up to 3 or 4, increased the size of yield components of the main stem. Stalk height of the main stem decreased at the wider spacings, but increased from the main stem through the successive tillers. Days to anthesis was delayed 4 to 5 days by the increases in the spacing intervals.

These data indicated that late maturity was one of the characteristics of primary importance. A possible relationship of late maturity with an increase in tiller number, head weight, head length and stalk height was indicated by the developmental studies.

The correlation analysis indicated that the number of heads per plant, head weight, head length and peduncle diameter along with maturity were the most important characteristics in determining yield.

Head length possessed the highest heritability of the

characters studied, followed by head weight and then the values gradually declined to plant yield.

As a result of this investigation the author was led to conclude that the yield of a variety is determined by its hereditary influence on tiller number, head weight and late maturity. Microfilm \$2.00; Xerox \$5.00. 98 pages.

**PREDICTING THE PERFORMANCE OF  
SYNTHETIC VARIETIES OF ALFALFA  
FROM SINGLE CROSS DATA**

(L. C. Card No. Mic 59-1288)

Laurie Clarence Pearson, Ph.D.  
University of Minnesota, 1958

Adviser: W. M. Myers

The study was designed to secure data on the possibility of predicting the performance of synthetic varieties of alfalfa from the behavior of all possible single crosses among the clones of which each is composed.

Each of three synthetic varieties was compared with the average of all the possible single crosses that could be produced from its parental clones. The comparisons utilized data on bacterial wilt, common leafspot, Pseudoplea leafspot, and blackstem resistance, recovery after cutting, winter injury, forage yield, and stand persistence. The data indicated that in the case of bacterial wilt, common leafspot, Pseudoplea leafspot, winter injury, and persistence, synthetic variety performance coincided with average single cross performance. On the other hand, significant differences were observed between synthetic variety and single cross behavior in the case of blackstem resistance, recovery after cutting, and forage yield. It was suggested that some estimate of decline in vigor due to loss of heterozygosity following synthesis might be made for each clone used in a synthetic in order to get a more reliable estimate of its performance; study of  $S_1$  progeny of each parental clone could provide such an estimate.

The progeny of fifteen single crosses totaling about 1300 individual plants were scored for common leafspot. The scores were distinct enough and the ratings were sufficiently uniform across all replications that a factorial analysis was attempted. It was not found possible to explain the observed segregation with any disomic scheme involving either one or two pairs of genes. However, the data fit very satisfactorily a monohybrid tetrasomic model assuming maximum equational segregation. According to this model, the quadriplex, triplex, and duplex genotypes result in resistance, the simplex in an intermediate reaction, and the nulliplex in complete susceptibility. There were no  $F_2$  or backcross data available to test the genotypes of any of the progeny and so the suggested model must be considered only a tentative one.

Comparison of forage yield of alfalfa in a spaced planting to yield in a drilled stand seeded at the rate of nine pounds per acre revealed that 39% of the variation in the drilled seeding was accounted for by variation in the spaced planting. Comparisons between the thick seeding of nine pounds per acre and a thin seeding of two and one-fourth pounds per acre gave a very satisfactory association of 88%. Microfilm \$2.00; Xerox \$4.80. 92 pages.



## A STUDY OF RED CLOVER VEIN MOSAIC VIRUS

(L. C. Card No. Mic 59-976)

Evamarie Sander, Ph.D.  
Cornell University, 1958

Studies of host range and physical properties confirmed the identity of a strain of red clover vein mosaic virus biologically purified by serial passage through local lesions on *Gomphrena globosa*. *Lotus corniculatus*, *Nicotiana rependa*, and *Capsicum frutescens* were found to be not susceptible, and *N. tabacum* was found to be susceptible in certain instances. The virus did not become systemic in *G. globosa*, the local-lesion host used for assays. A seasonal change in apparent virus titer in red clover was observed, the apparent titer being highest in January and lowest in May. Infected red clover plants proved better source plants for the virus than did infected plants of *Pisum sativum*, *G. globosa*, or *Vicia faba*. Mechanical transmission was most successful in all hosts when young leaves were inoculated. Addition of the antioxidant cysteine (pH 4 or 5) to freshly prepared inocula increased the apparent virus activity, as indicated by bioassays on *G. globosa*. Cysteine also tended to preserve infectivity when inocula were stored for 3 days in a freezer and at 25°C. In general, loss of infectivity of inocula stored at -10°C was less than the loss of infectivity in those kept at 25°C. As a diluent, cysteine at pH 4 or 5 was superior to cysteine at pH 6, to acetate or phosphate buffers at pH 4, 5, or 6, and to deionized water; water was superior to acetate or phosphate buffers. Clarification by centrifugation before freezing increased the apparent infectivity of 1:5 aqueous extracts of infected leaves. Plants of *G. globosa* darkened for 24 hours after inoculation produced more lesions than did control plants kept in continuous light. Darkening of *G. globosa* for 24 hours prior to inoculation proved to be detrimental to lesion formation. Infection by red clover vein mosaic virus decreased the rate of apparent photosynthesis of red clover leaves; this depression increased as symptom severity increased. Virus infection increased the rate of respiration; this effect was most pronounced 3 weeks after inoculation (and persisted at least for 9 weeks after inoculation). Ash and total nitrogen contents, when expressed on a dry weight basis, also were increased by virus infection; the differences in ash content between healthy and diseased tissue were greatest 3 weeks following inoculation whereas the differences in nitrogen content between healthy and diseased tissue was greatest 9 weeks after inoculation. Attempts to characterize the virus by purification and electron microscopy were unsuccessful. Inclusion bodies, both amorphous and crystalline, were found in leaf hairs of diseased red clover.

Microfilm \$2.00; Xerox \$3.00. 43 pages.

## THE PRODUCTION AND BOTANICAL COMPOSITION OF LEGUME-GRASS COMBINATIONS AND THE INFLUENCE OF THE LEGUME ON THE ASSOCIATED GRASSES

(L. C. Card No. Mic 59-1303)

Gayatri Prasad Tewari, Ph.D.  
University of Minnesota, 1958

Adviser: A. R. Schmid

The important role of legumes in raising and maintaining the production of pasture and hay crops has long been known. One of the many problems encountered is how to maintain a proper proportion of legumes and grasses composition in a mixture so as to get maximum production without causing bloat.

In order to study the above problem three types of investigations, namely, four small plot clipping studies, a large plot pasture study, and four row distance studies were conducted. The forage species used were Vernal alfalfa (*Medicago sativa* L. variety-Vernal), ladino clover (*Trifolium repens* L.), meadow fescue (*Festuca elatior* L.), smooth brome grass (*Bromus inermis* Leyss, variety-Lincoln), timothy (*Phleum pratense* L.) and alsike clover (*Trifolium hybridum* L.).

Small plot clipping studies and the large plot pasture study were to evaluate the desirability of growing legumes in rows between rows of grass or grasses as compared to a mixture. The row distance studies were designed to measure the influence of an alfalfa row on grass rows placed at six, 12, 18 and 24 inches from the nearest alfalfa row.

In the first two types (small plot clipping studies and large plot pasture study) of investigations, three kinds of data forage production, botanical composition and protein content were obtained. In the case of the third investigation, forage production and protein content were determined.

Results obtained from the first two investigations, showed, that among the different treatments used, the mixture yielded more dry matter and protein per acre than other treatments. The other treatments were legumes in single rows alternating with the grass rows, legumes in two rows six-inches apart alternating with two grass rows and legumes in three such rows alternating with three grass rows. The mixture was also slightly higher in legume composition than the other treatments.

The results from the third type of investigation showed that a grass row six-inches away from the alfalfa row yielded more dry matter and protein and was higher in protein percentage than grass rows at 12 inches, 18 inches and 24 inches away from the nearest alfalfa row.

It appears from these results that growing legumes in single alternate rows, double alternate rows or triple alternate rows between grass rows is not a practical means of controlling the legume-grass composition. It did increase the grass percentage somewhat over the mixture by having the legumes in rows but too much dry matter yield was sacrificed to attain this result.

Microfilm \$2.00; Xerox \$3.80. 70 pages.



## ANATOMY

### A STUDY OF THE CONNECTIVE TISSUE OF REGENERATING SKELETAL MUSCLE AFTER DENERVATION

(L. C. Card No. Mic 58-5166)

Aloysius Ignatius Miller, Ph.D.  
Emory University, 1953

Rat skeletal muscle which had been denervated for 20 days was studied histologically by the use of Mallory's connective tissue stain and histochemically by a modified Hotchkiss method for staining tissue-bound polysaccharides during the first 120 days of regeneration.

Emphasis was placed upon the activity of the connective tissues during the process of regeneration. These tissues underwent change of a cyclic nature between the 12th and the 92nd days of regeneration. This cycle was characterized by steadily progressive dedifferentiation of the fibrous elements; increase in volume of the ground substance and increase in number, size, granularity and secretory-like activity of the fibroblasts until the 32nd day; thereafter, a reversal of this process with a regression toward the normal state was observed. The ground substance showed variation in its state of polymerization which occurred concomitantly with the cyclic histological changes of the connective tissue. This variation in the state of polymerization was visualized histochemically as progressive increase and decrease in the intensity of the Hotchkiss color reaction.

The muscle fibers presented over-all changes in volume and Hotchkiss reactivity (color) which paralleled and equaled in intensity those of the connective tissue elements with the exception of: (1) lesser Hotchkiss reactivity at the 12th day, and (2) continuation of the volume increase of muscle fibers until the 120th day.

The material which reacted with the Hotchkiss stain was identified in the normal and 32nd to 120th day muscles as glycoprotein and in the 12th through the 22nd day muscles as glycoprotein plus glycogen.

From these studies it was apparent that in the regeneration of skeletal muscle of the rat following prolonged denervation: (1) the muscle and its supporting substance acted as an integrated physiological unit; (2) repair of the muscle fiber and reestablishment of reinnervation was dependent upon the activation of physical and chemical changes within the connective tissue about the regenerating muscle, and (3) there was a temporal, perhaps causal, relationship between the presence of nerve fibers within the muscle bundle and the physical and chemical state of the connective tissue about the muscle bundle.

An interesting finding of this study was that muscle regeneration apparently occurs at a uniform rate within muscle bundles but unevenly from muscle bundle to muscle bundle at any given time up until the 62nd day of regeneration.

Discussion of these findings included suggestions regarding the mechanism of connective tissue depolymeriza-

tion and the probable physiological roles played by connective tissue during muscle regeneration.

Microfilm \$2.00; Xerox \$3.00. 50 pages.

### THE HISTOLOGY OF THE BLADDER AND THE PROXIMAL URETHRA OF THE DOMESTIC ANIMALS

(L. C. Card No. Mic 58-2329)

Richard Dana Moore, Ph.D.  
Michigan State University, 1956

Comparative histological studies of the bladder and proximal urethra were made on forty-eight domestic animals of seven species. The transitional epithelium was highest at the vertex of the bladder. The horse had the highest epithelium, followed in decreasing order by the sheep, pig, cow, goat, cat, and dog; it was lowest in the bladder neck of the cat. The horse had the greatest number of cell layers at the vertex (13), followed by the sheep, cow, and pig (10), the goat (6), and the dog and cat (5). It was impossible to distinguish the species, or any particular region of the bladder, by the shape of the transitional epithelial cells. Lymphocytes occurred in the bladder epithelium, more frequently in the cow and less frequently in the cat. Glands were not observed in any area of the bladder wall of any domestic animal studied. There was a continuous layer of capillaries under the epithelium of some goats. Lymphoid nodules were observed in the tunica propria of most of the cow bladders. The muscularis mucosae was best developed in the horse, very thin in the cow, dog, and pig, represented by only a few muscle cells in the sheep and goat, and not consistently present in the cat. Small ganglia were observed in the submucosa of the horse and cat bladders only. Fat often appeared in the connective tissue of the muscularis externa of the pig. Ganglia were observed in the muscularis externa of all domestic animals except the sheep and the goat. The serosa of the horse, cow, and dog was thickest; less thick in the sheep, goat, and pig; and thinnest in the cat. The serosa of the cat had the largest amount of elastic tissue, contained ganglia, and fat. Fat was also observed in the serosa of the horse and pig.

The transitional epithelium of the proximal urethra of all animals was similar in height and structure to that of the bladder neck. The density of the tunica propria appeared greater toward the epithelium in all animals except the cow. Smooth muscle appeared in the tunica propria of all animals except the cat; the horse had the most; in the pig, dog, and sheep it was confined to an area near the muscularis externa; and muscle bundles were absent but individual muscle cells were present in the cow. Glands were present in the tunica propria of the boar and male dog, but not observed in any other animal. The urethra of



the sheep and the goat had a single layer of smooth muscle; the cat and dog had two layers of muscle, entirely smooth in the cat and female dog but in the male dog skeletal muscle appeared in both layers; in the cow, horse, and sheep three layers of smooth muscle were present. Skeletal muscle was observed in the bull and the boar. In the boar it was thick ventrally, thin laterally, and absent dorsally. The connective tissue in the muscularis was scant in the cat and pig, and increased in amount in the dog, sheep, goat, and horse. In addition, elastic fibers appeared in greater numbers in the horse. Fat appeared between the

prostate and muscularis externa of the pig bladder. No sex differences were noted in the bladders of domestic animals. No sex differences in the proximal urethra were observed other than those due to basic anatomical differences in the reproductive systems. While it was impossible to differentiate most of the bladders of the domestic animals by a histological examination, the cat bladder might be characterized by a combination of the following observations: an almost complete absence of a muscularis mucosa, a thin serosa with an abundance of elastic tissue in it, and by its relatively thin epithelial layer.

Microfilm \$2.00; Xerox \$6.40. 134 pages.

## ANTHROPOLOGY

### WALAPAI CULTURE-HISTORY

(L. C. Card No. Mic 58-3513)

Robert Clark Euler, Ph.D.  
University of New Mexico, 1958

This dissertation is a study of the culture-history of the Walapai Indians, an upland-Arizona Yuman-speaking tribe. These Indians ranged, in the historic period, essentially from the Colorado River on the north and west, to the Bill Williams Fork-Santa Maria River on the south, and the Cataract Creek drainage on the east. The same region was occupied prehistorically by the Cerbat Branch, a group included by archaeologists within the Patayan Root, and recognized temporally from about 700 to 1150 A.D.

This study is an attempt to determine whether or not the historic Walapai, known as such since 1776, are related to the prehistoric Cerbat people. Ethnographical, historical, and archaeological methods are utilized in a direct-historical approach to the problems of identifying traits by which the occupants of the area may be determined, and the reconstruction of their culture in time.

A second major problem relates to the prehistoric affinities of two other upland-Arizona Yuman-speaking tribes, the Havasupai and Yavapai. Between 700 and 1150 A.D. the area of the former was inhabited by the Cohonina Branch, and that of the latter in part by the Prescott Branch. Some archaeologists are of the opinion that the three historic groups---Walapai, Havasupai, and Yavapai---are directly descendant from the three prehistoric branches---Cerbat, Cohonina, and Prescott---who inhabited respectively the same territories.

Field work in this study began in 1953, and involved

ethnographic research with thirty-five informants, historical investigations dating to 1776, and the excavation of ten archaeological sites selected from six hundred recorded in the area.

The date indicates that the Cerbat Branch peoples moved from the Lower Colorado River to their maximum inland range on the plateau of north-west central Arizona between 1150 and 1300 A.D. Prior to that time the plateau region was occupied principally by the Cohonina until 1150 A.D., and to a lesser extent by enclaves of the Prescott Branch until 1300 A.D. By the latter date the Cerbat had displaced both other groups. It is highly probable that the Cerbat Branch is ancestral to the historic Walapai and Havasupai, who have considered themselves as one culture, the Pai, distinct from the Yavapai. Little empirical data are available concerning the latter tribe, although they appear to have no direct ancestry with the Prescott Branch, no evidence of which is present post-1300 A.D.

Theoretical questions are approached on two levels. The more specific has to do with previous statements concerning the prehistory of the area, which have attacked the problem working from unknown to known, and which have erred in reconstruction by some eight centuries. On this same level, data are presented relative to the dynamics of culture change as seen in one thousand years of Walapai culture-history. Closely allied, but on a somewhat greater plane, cultural ecological theories are seen not to apply to the Pai, who changed their culture almost not at all in moving to different environments, only to have it rather abruptly terminated by the impact of Anglo-American settlement, which resulted in the utilization of the territory in a different manner.

Microfilm \$5.05; Xerox \$17.00. 396 pages.



## ASTRONOMY

### THE NOVA OUTBURST

(L. C. Card No. Mic 59-805)

Stuart Robert Pottasch, Ph.D.  
University of Colorado, 1958

Supervisor: Dr. Harold Zirin

It is the purpose of this thesis to understand quantitatively what occurs during novae outbursts, a subject which, up to the present, has been discussed only qualitatively. To do this, all the quantitative observations pertaining to the spectrum of the six best observed novae and to the nebulosity ejected by these six novae, have been gathered and subjected to analysis.

After an initial discussion of the essential observations which comprise the nova phenomenon, a summary is given of the important modern interpretations with a criticism of the plausibility and consistency of these arguments. From these arguments, a likely, simple shell model of the nova outburst is chosen as the basis for subsequent analysis. The model is examined to decide whether it can adequately reproduce the observations, and if it can, whether it is the only model which can do so. Then a detailed study of the transfer of radiation in the shell and its subsequent cooling when it is opaque to visible radiation is given, and it is shown that the surface luminosity and temperature of the shell as function of time match the novae light curve and temperature variation over the same period of time. This analysis may have application to many other problems besides the nova shell.

The state of ionization of the hydrogen in the shell is considered next. It is shown that the existing theory, due to Stromgren, while giving the correct qualitative description of a sharply bounded HII region, is wrong when considered quantitatively. This is primarily because Stromgren's theory neglects the diffuse (scattered) radiation. A theory which takes the diffuse radiation into account is developed and it is shown this theory reduces to Stromgren's result if certain simplifications are made, including the neglect of the diffuse radiation field. Examples are worked in detail, showing that a given ionizing flux actually penetrates about 10 times as far into a gas as Stromgren's theory would predict.

The electron density and temperature of the shell can be found from the observations of H $\alpha$  and [OIII]. These measurements confirm the shell model used and show that an ionized HII region begins to penetrate the shell noticeably just as the intermediate or transition stage (usually marked on the light curve) begins, and has completely penetrated the shell exactly when this stage ends and the nebular stage begins. The total hydrogen mass of the shell is also found. The mass of helium in the shell is found from the HeII 4686 line, and the measurements of hydrogen and helium together may be used to derive a temperature and radius of the central exciting star which are given in tabular form for each nova as a function of time. The plausi-

bility of these values is checked by comparing the total energy radiated by the central star before the nebular stage, with the total energy found to be radiated by considering the light curve. A more exact check is made by computing the extent of the HII ionized region due to an exciting star of this temperature and radius using the theory developed previously, and comparing this extent to that observed from the discussion of the H $\alpha$  measurements.

Finally, the composition of the nova shell is found from the observations of other elements. This parameter is of importance for a discussion of the evolution and the cause of the nova outburst, neither of which are discussed in this thesis. It appears that the abundance of oxygen, nitrogen and calcium (and possibly many other elements as well) are at least several times more abundant in novae as is now commonly acceptable in more conventional astronomical objects. Microfilm \$2.00; Xerox \$6.00. 124 pages.

### ABSOLUTE PHOTOMETRY OF THE AURORA

(L. C. Card No. Mic 59-807)

Manfred Hugh Rees, Ph.D.  
University of Colorado, 1958

Supervisor: Professor William A. Rense

The great low latitude aurora of March 1/2, 1957 was measured photometrically. The three most prominent emission features,  $\lambda 3914$  band of the First Negative system of N $_2^+$ ,  $\lambda 5577$  emission of OI, and  $\lambda 6300/6364$  of OI, were recorded continuously throughout the night in the meridian sweep. These emissions were isolated with narrow band interference filters. Absolute calibration was carried out by a star deflection procedure referred to the solar emission curve and all the data are presented in absolute intensity units, kilorayleighs ( $10^9$  quanta/cm $^2$ sec-column). Corrections for the scattered light and atmospheric extinction were made.

Intensities equivalent to an auroral I.B.C. (International Brightness Coefficient) greater than III were recorded during portions of the night. The ratio of the instantaneous intensities I(O) 5577 to I(O) 3914 was found to be essentially constant over an intensity range of three decades and to be independent of the type of auroral form. Small departures of this ratio from constancy during the night are interpreted in terms of variations in the extinction coefficient or in terms of a latitude effect. A strong enhancement of I(O) 3914 in the early morning hours was shown to be a sunlit aurora. Attempts to interpret the data, obtained as a function of zenith distance, in terms of heights above the earth's surface proved inconclusive. However, the maximum height at which the blue sunlit aurora was first measurable was determined to be 700 km. for this aurora. The ratio of intensities I(O) 6300 to I(O) 5577 was found to vary



systematically with intensity, approaching a constant value at sufficiently high intensities. Enhancement of the OI 6300 emission was found in the sunlit atmosphere, but no such enhancement was recorded for the OI 5577 line. The aurora in the blue light ( $\lambda 3914$ ) and the green light ( $\lambda 5577$ ) was restricted principally to the northern horizon, rarely extending above a zenith distance of  $70^\circ$ . The aurora in the red light ( $\lambda 6300$ ) extended over the entire northern half of the celestial hemisphere, and frequently spilled over to the southern half.

The intensities and correlations obtained are consistent with the following excitation mechanisms. In the dark atmosphere, the First Negative system of  $N_2^+$  is excited from ionizing collisions of protons and/or electrons of high energy with  $N_2$  molecules. The OI 5577 line results from secondary electrons, arising from the primary ionization process above, colliding inelastically with oxygen atoms. With the known abundances and rate coefficients the above processes can easily account for the observed emission rates. The OI red lines are also primarily excited by electron impact. However, these need not be secondary electrons, but could be ionospheric electrons which have acquired the necessary energy by some other accelerating mechanism. At the lower heights collisional deactivation is strongly competitive with the radiative transition giving rise to  $\lambda 6300/6364$ . Several other mechanisms might contribute to the red emission but none have as high a quantum yield as electron impact. Different mechanisms are operative in the sunlit aurora. Atmospheric 'sensitization' and resonance excitation of  $N_2^+$  account for the blue sunlit aurora. From the data the ion density of  $N_2^+$  is calculated as a function of height. Resonance excitation of the oxygen atoms also accounts for the red sunlit aurora.

Microfilm \$2.25; Xerox \$7.80. 170 pages.

# GEODETIC APPLICATIONS OF OBSERVATIONS OF THE MOON, ARTIFICIAL SATELLITES AND ROCKETS

(L. C. Card No. Mic 59-433)

George Veis, Ph.D.  
The Ohio State University, 1958

A pure geometrical approach to the geodetic problems is possible by performing a three-dimensional triangulation, using the moon, artificial satellites, and rockets as triangulation points.

A geocentric rectangular coordinate system is defined, in which the direction of an object can be determined by photographing it against the stars. Depending on the apparent velocity of the object and the photographic camera used, an accuracy of  $0''.5$  to  $5''$  can be obtained.

If the position of the object is known, as in the case of the moon, a space resection which will give the positions of the stations can be developed.

If the position of the object is unknown, simultaneous observations of the object from both known and unknown stations are required. A connection of the unknown stations to the system of the known stations can be obtained.

If the observed object is an artificial satellite, a solution is possible, which will give simultaneously both the positions of the observing stations and the elements of the satellite's orbit. If an accurate ephemeris for the satellite is on hand, the same method as for the moon can be used. Simultaneous observations for geodetic connections can be used as well.

It follows that we can expect an accuracy of about  $\pm 30$  m. for the positions of the stations. The accuracy is expected to be better than  $10^{-5}$  in case of geodetic connections by simultaneous observations of rockets.

Microfilm \$2.30; Xerox \$8.00. 174 pages.

## BACTERIOLOGY

### IN VITRO STUDY OF A VIRUS-CARRIER STATE IN MAMMALIAN CELLS

(L. C. Card No. Mic 59-790)

Steven Joseph Cieciura, Ph.D.  
University of Colorado, 1958

Supervisor: Professor Theodore Puck

Certain aspects of the nature of a virus-carrier state in mammalian cells, Newcastle Disease virus and HeLa, were investigated: (1) origin and stability of the virus-carrier lines, (2) the comparison of the morphological and growth characteristics of a virus carrying strain with HeLa S3, (3) development of a plaque technique to quantitate the virus carrying property of the carrier population, (4) nature of the carrier cell resistance to superinfection, (5) cellular location of the carried virus, and (6) the effect of specific anti-virus serum on the virus-carrier state.

Newcastle Disease virus-resistant mutants, present in

the parental HeLa population, were obtained through the regrowth and clonal isolation of cells which resisted the destructive action that the virus exerted on the majority of the population. Such virus-resistant clonal lines and the infecting virus were found to co-exist in stable association without manifestation of cytopathology. Clonal virus-carrier lines have been maintained for 3 years, undergoing more than 150 subcultivations and approximately  $10^3$  generations of growth without any noticeable change in properties.

Morphological and growth comparison of the virus-carrying strain with HeLa S3 cells revealed: (a) both cells exhibited approximately equal rates of growth, a doubling time of 18-20 hours, (b) in a sufficient medium, virus-resistant carrier cells exhibited a colony efficiency of only 50-80 per cent, whereas HeLa S3, under identical conditions, plated with an efficiency of approximately 100 per cent, and (c) colonial morphology of both strains are similar except for the tendency of the virus-carrier cells to form multinucleated giant cells with increased frequency.



A plaque technique was devised utilizing the virus sensitivity of x-irradiated HeLa S3 cells and an agar overlay medium which indicated that the majority of the virus-carrier cell culture was capable of forming plaques. In addition, quantitative comparison of the plaque and colony forming efficiencies of virus-carrier cells indicated that the population consisted of 3 types of cells: (a) cells capable only of producing plaques, (b) cells capable of forming colonies only, and (c) cells possessing the dual potentiality of producing either a plaque or a colony, depending upon the conditions of the test. The fundamental differences and similarities between virus-carrying cells possessing the dual potentiality and lysogenic bacterial cells were discussed.

Virus-resistance of the carrier cells was studied by the virus challenge of large populations, and by single cell techniques. These results indicated that the cells were resistant to low input virus multiplicities, but were perhaps susceptible to high doses of virus, depending upon the metabolic state of the cells at the time of the test. The mechanism for this resistance was demonstrated as being due to the inability of the cells to adsorb the infecting virus.

Hemagglutination studies, utilizing the property of NDV to agglutinate chick red blood cells, revealed that NDV antigens were present at or near the outer surface of the carrier cells. The specificity of this agglutination was demonstrated by its inhibition by specific anti-NDV serum. The possibility of additional intracellular virus had not been excluded.

Prolonged exposure of carrier cells to specific anti-virus serum, followed by the clonal isolation of colonies arising from single cells, was successful in eliminating the virus-carrier state in all but a small fraction of the population. These results indicated the susceptibility of the carried virus to extracellular influences, but the cells retained their resistance to NDV infection. Therefore, the virus resistance of the virus-carrier cell population was attributed to a genetic constitution different from that of other HeLa clones, such as S3.

Microfilm \$2.00; Xerox \$4.60. 86 pages.

#### OBSERVATIONS ON THE LIPASE ACTIVITY OF STAPHYLOCOCCI AND OF STAPHYLOCOCCAL COAGULASE

(L. C. Card No. Mic 58-5137)

Margaret Crawford Drummond, Ph.D.  
Emory University, 1958

A highly purified preparation of staphylococcal coagulase has been observed to produce opacity in an egg yolk medium. The discovery of a second activity in purified coagulase preparations raised the question of whether it was separable from the well-known plasma clotting reaction of coagulase, or whether both activities are properties of the same molecule.

The nature of the egg yolk produced by purified coagulase preparations was studied by comparison of the visible reaction of coagulase on egg yolk, with the action of several purified enzymes on the same substrate, and by several chemical analyses. The production of acid following the action of coagulase on egg yolk introduced the possi-

bility that lipase activity might be present. This was borne out by the assay of coagulase for lipase activity using different substrates.

The reaction between coagulase and egg yolk was studied kinetically. It was characterized as to pH optimum, temperature optimum, and substrate specificity, as was the coagulase-tributyrin reaction also.

The problem of whether the two activities of coagulase were properties of a single protein, or of more than one protein, has proved the more difficult problem to resolve. Because of the difficulties associated with the use of physical methods in determining the homogeneity of a protein, a direct attempt at further fractionation did not seem indicated. Several methods of investigation were used in the attempt to obtain indirect evidence for the separability or identity of the two activities. These methods included an attempt to neutralize the two activities of coagulase by specific antiserum fractions, a study of the differential effects of heat, trypsin, and known enzyme inhibitors on the two activities, and, in addition, a study of the occurrence of these two activities in a number of clinically isolated strains of staphylococci.

The  $\alpha$ -globulin fraction of immune rabbit serum was found to neutralize the plasma clotting activity completely at a concentration which neutralized the tributyrinase activity only 66%. Another immune serum fraction, consisting of  $\beta$ -globulin, had no effect on coagulase clotting but neutralized tributyrinase to the same extent as did the  $\alpha$ -globulin fraction.

It has been found (Kirk, 1934; Campbell and Fourt, 1939; Adams, 1942) that antibodies to proteins with enzymatic activity do not necessarily neutralize that activity. The explanation has been that the site of enzymatic activity need not be the site of enzyme-antibody union. Thus, the finding that specific anticoagulase neutralized the tributyrinase activity of coagulase 66% could be explained by the concept that the two activities reside on the same molecule, but that the portion of the molecule involved in union with antibody might be different from that exhibiting tributyrinase activity.

On the other hand, if the antigen employed in immunization contained more than a single antigenic material, it is reasonable to assume that multiple antibodies would be formed in response to its administration. The finding that the  $\beta$ -globulin fraction of the antiserum partially neutralized the tributyrinase activity only, whereas the  $\alpha$ -globulin fraction neutralized clotting completely and tributyrinase 66%, indicates the presence of more than a single antibody, and of more than a single antigen.

The studies of the differential effects of heat, trypsin, and certain enzyme inhibitors on the two activities of coagulase suggested a separation of the two activities. Both heat and trypsin, as well as three of the five inhibitors studies, showed differential effects, whereas only two of the inhibitors showed similar effects on the two activities.

The direct evidence for the probable dual origin of the plasma clotting and tributyrinase activities associated in purified coagulase preparations came from the work with different strains of staphylococci. The study of 85 strains of staphylococci in regard to their plasma clotting, egg yolk opacity production, and tributyrinase activities showed that any one of the three activities can be present in the absence of the others. Additional proof of the distinctiveness of the tributyrinase and plasma clotting was realized



with the finding of staphylococcal strains which produce a single activity only.

Microfilm \$2.40; Xerox \$8.40. 181 pages.

#### HOST RESISTANCE IN SYSTEMIC MYCOTIC INFECTIONS

(L. C. Card No. Mic 58-7949)

Gilbert Alfred Hill, Ph.D.  
University of Utah, 1958

Chairman: Dr. Stanley Marcus

In spite of the vast amount of data that have accumulated in the field of bacterial and viral immunity, little is known concerning resistance mechanisms toward the systemically pathogenic fungi. A study was therefore begun to gain some insight into the virulence characteristics, host susceptibility, and resistance mechanisms of some of the systemic mycoses.

The virulence, as demonstrated by LD<sub>50</sub> determinations, of several strains of *H. capsulatum*, *B. dermatitidis*, *C. albicans* and *Cr. neoformans* maintained an antibiotic containing blood agar medium and incubated at 37°C, was followed for different periods of time. While there was a significant difference among strains of the same organism, the virulence of the specific strains did not change to a significant extent over the period of study.

A large variance in susceptibility to infection with histoplasmosis was observed to exist among the animals studied. Mice were reproducibly infected with *H. capsulatum*; however, monkeys (*Macacus irus* and *M. rhesus*) were shown to be highly resistant to infection.

Mice were immunized against histoplasmosis. The extent of resistance to intravenous challenge was significantly higher in mice injected with killed whole yeast phase cells, or protein free polysaccharide fractions of *H. capsulatum* than in normal nonimmunized animals. A significant increase in resistance was also engendered by chronic sublethal infection. It was observed that a slight but significant increase in survival was apparent in mice challenged with *B. dermatitidis* after being injected with living organisms of a less virulent strain.

A comparison of various parenteral routes of injection of histoplasma vaccine resulted in the same order of resistance being induced by each. Mice immunized by intramuscular, intradermal, intraperitoneal, and intravenous routes gave significantly lower mortality ratios than did orally immunized or normal mice after challenge with varying numbers of virulent organisms.

Insight into the cellular defense mechanisms involved in mouse histoplasmosis was gained by *in vivo* and *in vitro* experiments utilizing cell culture techniques and isotope labeled yeast phase cells of *H. capsulatum*. The results obtained by a number of different methods suggest that the "immunized" macrophages are able to limit the growth of the parasite *in vitro* for a significantly longer period and destroy this organism at a more rapid rate than can the "normal" phagocytes. The mechanisms involved seem to be related to increased intracellular digestive capacity rather than to a system dependent upon antibody.

Therapeutic experiments on several of the more promis-

ing antifungal agents show that only the congeners of stilbamidine and the antibiotic eulicin are effective in treating systemic blastomycosis in mice. These drugs showed no therapeutic effect in mice infected with the other fungal agents studied. Microfilm \$2.00; Xerox \$5.40. 106 pages.

#### GENETIC STUDIES ON *SPIRILLUM LUNATUM*

(L. C. Card No. Mic 59-866)

Beatrice Lucia Kelly, Ph.D.  
University of Southern California, 1958

Chairman: Professor Sydney C. Rittenberg

The marine organism *Spirillum lunatum* was studied in an attempt to discover the genetic significance of the apparent fusion processes which had been observed and photographed by Williams and Rittenberg (1956). In the work reported by these authors, these fusion processes appeared to be related in some cases to the intertwining of cells which occurs in cultures of *Spirilla*, although in other instances two cells touching end to end appeared to fuse. In all cases the apparent fusion resulted in the production of a rounded body which was considered to be a microcyst, equivalent to the microcysts formed in old cultures by the shortening and rounding up of vegetative cells.

In the present work it was necessary to develop complete and minimal media which would allow consistent growth from small inocula. For this purpose it was necessary to add iron to the peptone sea water media, and iron and EDTA to the succinate sea water minimal media.

By the use of ultraviolet irradiation combined with exposure to penicillin, 7 mutant strains exhibiting single nutritional deficiencies and 4 mutant strains with double nutritional deficiencies were isolated. One-step streptomycin resistant mutants were derived from the double nutritional mutants.

Using the mutants obtained, 16 recombination experiments were set up, representing a total of 137 crosses attempted. In the course of these experiments, the manner of preparing cultures was varied with respect to the number of organisms, the age of the cultures, the phase of the life cycle, and the use of shake cultures and of stationary cultures. Conditions during mixing of cultures were varied with respect to the suspending fluid, using peptone broth, sea water, and succinate sea water medium without NH<sub>4</sub>Cl, and also with respect to the degree of aeration, the pH, and the duration of mixing before subjecting the cells to selective conditions. The selective system was varied by selecting for prototrophy or for prototrophy plus streptomycin resistance, and by selecting for the transfer of two characters or of one character.

Although no evidence of recombination was obtained, it cannot be concluded that recombination does not occur, since there are many untried experimental variations possible. However, if recombination does occur, it is unlikely that it is correlated with the observed intertwining, since intertwining is readily observable microscopically in most cultures, while recombination was not detected when more than 10<sup>8</sup> cells of each of two mutant strains were mixed.

By exposure to penicillin, osmotically fragile rounded bodies or "protoplasts" were formed which remained stable



in sea water or in sea water media but which lysed immediately when suspended in distilled water. Spiral vegetative cells also lysed immediately when suspended in distilled water. Microcysts showed no drop in turbidity when suspended in distilled water.

The existence of "protoplasts" which are stable in sea water and which can be differentiated from microcysts raises the possibility that the rounded bodies originally reported to occur in cultures of *S. lunatum* may not all have been equivalent structures. The possibility exists that only those rounded bodies produced by shortening and rounding up of vegetative cells are microcysts, which are normal forms in the life cycle of the organism, while those produced by absorption of cellular contents into a protuberance, in cells lying alone, in intertwining cells, or in cells touching end to end, are "protoplasts" and should be considered products of injury or of unfavorable conditions.

This possibility that the end result of the observed fusion processes may have been "protoplasts" instead of microcysts makes necessary a re-evaluation of the significance of these processes.

Microfilm \$2.00; Xerox \$5.20. 101 pages.

#### THE OXIDATION OF ALPHA-KETOGLUTARATE BY *PSEUDOMONAS AERUGINOSA*

(L. C. Card No. Mic 58-3354)

Richard L. Leavitt, Ph.D.  
University of Pennsylvania, 1958

Supervisor: D. J. O'Kane

#### PART I. THE OXIDATIVE DECARBOXYLATION OF ALPHA-KETOGLUTARATE

The oxidative decarboxylation of alpha-ketoglutarate, by a cell-free extract of *P. aeruginosa*, was shown to be dependent on the presence of DPT, DPN, lipoic acid, and CoA. The requirements for DPT, DPN and lipoic acid were demonstrated by removal of these cofactors through dialysis and their subsequent replacement. The removal of the cofactors was accomplished by rapid dialysis for four hours against M/30 phosphate buffer pH 7.2. CoA requirement was demonstrated by removal through treatment with Dowex 1.

The decarboxylase was purified seven fold by treatment with protamine sulfate and ammonium sulfate fractionation.

Evidence is presented which is interpreted to indicate that diphosphothiamine and lipoic acid share the same apoenzyme.

The use of ferricyanide as an electron acceptor in the study of the decarboxylase prompted an investigation of the ferricyanide reducing system. An enzyme, which sediments at 180,000 x g, is implicated in the reduction of ferricyanide at the aldehyde-diphosphothiamine level. It is probable that ferricyanide can act as an electron acceptor at both the aldehyde-diphosphothiamine and acyllipoic acid level.

#### PART II. THE ANAEROBIC DECARBOXYLATION OF ALPHA-KETOGLUTARATE

A dismutase of alpha-ketoglutaric acid is described in which two moles of alpha-ketoglutarate are used to form one mole of succinate, one mole of CO<sub>2</sub>, and one mole of alpha-hydroxyglutarate. Alpha-hydroxyglutaric acid was identified through paper chromatography. Alpha-ketoglutarate was produced aerobically from the products of the dismutase by a cell-free extract of *P. aeruginosa*. Microfilm \$2.00; Xerox \$3.00. 58 pages.

#### THE EFFECT OF ENVIRONMENTAL FACTORS ON THERMAL RESISTANCE OF MICROCOCCI AND ASSOCIATED ORGANISMS IN MILK

(L. C. Card No. Mic 59-1283)

Allan Norman Myhr, Ph.D.  
University of Minnesota, 1958

The effect of various cleansing and sanitizing procedures on the selection and heat resistance of the mixed microflora in aseptically drawn milk and milk contaminated with materials from external sources was investigated. To simulate conditions in dairy equipment, films from milk samples were prepared on stainless steel strips. The strips then were repeatedly exposed to (a) water at different temperatures, (b) an alkaline cleanser, (c) the cleanser followed by a hypochlorite sanitizer, (d) the cleanser followed by a quaternary ammonium sanitizer, and (e) an iodophore detergent sanitizer. The strips were allowed to dry after treatment. The microorganisms which survived after a given treatment were enriched by immersing the strips in sterile milk and allowing growth for a time in the milk films on the strips before the next treatment.

The heat resistance of micrococci on steel strips coated with aseptically drawn milk was not appreciably altered by any of the treatments applied to the strips. With one sample of aseptically drawn milk, thermotolerant streptococci emerged after 32 to 35 days on strips treated daily with water at 50°C, 60°C and when cleanser was used. These organisms did not appear when the treatments involved both cleanser and hypochlorite, cleanser and quaternary ammonium compound and the iodophore.

When the steel strips were coated with milk contaminated with scrapings from the coats of cows and with a mixture of coat scrapings and cow feces, no thermotolerant micrococci developed on the strips during the course of treatment with the various agents. One sample produced thermotolerant streptococci on strips exposed to water at 50°C, 60°C and the cleanser. In another sample, thermotolerant sarcinae emerged on a strip treated with the iodophore.

When thermotolerant streptococci developed on strips, they did so very rapidly (within 4 days) after the commencement of treatments. The heat resistant sarcinae emerged more slowly, requiring approximately 16 days before they were present in appreciable numbers.

Treatment of strips with hot water accelerated the rate of build-up of thermotolerant streptococci but was found to be ineffective in increasing the heat resistance of



non-thermoduric streptococci and micrococci. This also was observed when milk suspensions of organisms were heated at 61.7°C for 30 minutes and the survivors grown out and reheated.

Low temperature storage (5°C) of 6 milk cultures prepared from treated strips originally coated with aseptically drawn milk caused, for the most part, a slight reduction in heat resistance of the organisms. The latter were predominantly micrococci.

No change in heat resistance occurred with 2 pure cultures of micrococci isolated from aseptically drawn milk when these were placed on steel strips and subjected to the different treatments. Also, heat susceptibility was not altered when the above cultures and 4 additional pure cultures of micrococci (one from a dairy feed concentrate, 2 from the coats of cows and one from hay) were grown in broth, washed and exposed to high concentrations of cleanser, hypochlorite, quaternary ammonium compound and an iodophore detergent-sanitizer.

It was concluded that the heat resistance of organisms in milk and on dairy equipment is not likely altered appreciably by such factors as dessication, chemical treatments and temperatures used in dairy farm sanitation. Thermoduric organisms arise in milking equipment largely as a result of selection by such treatments with subsequent enrichment in milk residues on poorly cared-for utensils.

Microfilm \$2.00; Xerox \$6.20. 126 pages.

#### DEXTRAN REACTIVE ANTIBODIES IN HUMAN SERUMS

(L. C. Card No. Mic 59-861)

Alexander Herman Pinkes, Ph.D.  
Cornell University Medical College, 1958

The thesis deals with the occurrence of dextran-reactive antibodies in human serums and with the increases in those antibodies which occurred with some individuals following injections of the usual typhoid vaccine.

The dextran-reactive antibodies were recognized by agglutination tests with the cells of a selected strain of *L. mesenteroides* which had been grown in sucrose-containing culture media. This agglutination method, although less direct than precipitation tests with solutions of dextran, had distinct advantages in respect to capacity to detect relatively low levels of dextran-reactive antibodies and also in respect to economy in time, labor, and materials required for tests of large numbers of serums.

The investigation was divided into three parts. The first comprised experiments with the antisera of laboratory immunized rabbits, which possessed known capacities to react with solutions of purified dextrans or with solutions of semi-purified non-dextran antigens of leuconostoc bacteria. The results brought out two major points. First, they demonstrated the capability of the agglutination tests with sucrose-grown leuconostoc bacteria to detect low concentrations of dextran-reactive antibodies. Second, they showed that the sucrose-leuconostoc agglutination caused by dextran-reactive antibodies could be distinguished from agglutination caused by antibodies reactive with non-dextran components of the bacteria by absorption, by agglutination-inhibition tests and by treatment of the bacterial cells with

dextran-splitting enzyme. These two points established the suitability of the agglutination test as a method for the detection of the presence of dextran-reactive antibodies in human serums.

The second part comprised experiments with a collection of serums from humans, none of whom had received any recent injections of typhoid vaccine. The results showed that the majority of human serums contained dextran-reactive antibodies in amounts readily detectable by the sucrose-leuconostoc agglutination tests. That the antibodies responsible for the sucrose-leuconostoc agglutination of human serums actually were dextran-reactive antibodies was proven by absorption, agglutination-inhibition and enzyme experiments of the same sort as were used with the rabbit antisera in the first part of the work.

The third part of the study comprised experiments with serums of subjects that had been given the series of injections of typhoid vaccine that are routinely employed for prophylaxis. Two samples of serums were obtained for each individual: one about 1 week prior to the first injection and the other 3 weeks after the last injection. The majority of the subjects showed detectable increases in dextran-reactive antibodies following vaccination, as indicated by increased capacity of the post-vaccination serum to agglutinate the sucrose-grown leuconostoc bacteria. In the case of serums from subjects who had shown large increases in leuconostoc agglutination titre, the increase in dextran-reactive antibodies was demonstrated also by precipitation methods (routine visual tests and quantitative antibody-Nitrogen determinations). The dextran-reactive antibodies in the post-vaccination human serums were proven to be similar to the dextran-reactive antibodies contained in the antisera of *S. typhi* immunized rabbits, both by absorption and by agglutination-inhibition tests with structurally different dextrans. The results indicated that the dextran-reactive antibodies had been evoked by the direct antigenic action of the *Salmonella* bacteria contained in the typhoid vaccine; and that these antibodies were not the result of some "non-specific" stimulation.

Microfilm \$2.00; Xerox \$6.60. 139 pages.

#### AN INVESTIGATION OF PSYCHROPHILIC BACTERIA I. THE NATURE AND DISTRIBUTION OF PSYCHROPHILIC BACTERIA IN COMMERCIAL PASTEURIZED DAIRY PRODUCTS II. STUDIES OF THE INFLUENCE OF GROWTH AND REACTION TEMPERATURE ON THE METABOLISM OF A TYPICAL PSYCHROPHILE

(L. C. Card No. Mic 59-1297)

Walter Donald Schultze, Ph.D.  
University of Minnesota, 1958

Expanding applications of refrigerated storage and transport in the dairy industry emphasize the role in product deterioration of bacteria capable of relatively rapid growth at such temperatures. Fundamental studies of the nature and activities of psychrophiles have been few and conflicting. This study was designed to gain basic information about the taxonomic groups, relative frequencies of occurrence and bio-chemical activities of psychrophiles in commercially pasteurized dairy products. A study of



psychrophiles was designed to discover unique physiological capabilities helpful in explaining their increased ability to function at low temperatures. In preliminary investigations to test the feasibility of this approach, the influence of change in growth and reaction temperature on the limiting rate of a single metabolic system was investigated in resting cells of one psychrophilic bacterial species.

Fresh milk, cream, chocolate drink and cottage cheese samples collected at seven dairy plants were incubated at 4°C for 1-2 weeks, plated, and subcultures made of predominating colonial types after incubation at 7°. Classification by genus was based on the following observations at 25°: Gram reaction, cellular morphology, motility, flagellar arrangement, character of growth in broth, fluorescence, oxidase production, growth at 37°, changes produced in litmus milk, glucose and lactose fermentation, nitrate reduction, hydrogen sulfide formation, and hydrolysis of casein, gelatin, starch and butteroil. The 586 isolates were distributed as follows: 70.6% *Pseudomonas*, 65.2% of them fluorescent types; 7.9% *Alcaligenes*; 9.2% *Achromobacter*; 0.7% *Flavobacterium*; 10.8% coliform; and 0.8% yeast. The distribution of types in any given product conformed to this pattern with few exceptions. Fluorescent *Pseudomonas* strains were high in summer samplings of cottage cheese and low in cream; *Alcaligenes* strains were recovered far less frequently from cottage cheese than from other products; the incidence of coliforms was high in cream and low in cottage cheese; and coliforms were absent from chocolate drink in summer although frequently found in winter.

The Enteric Bacteriology Unit, Communicable Diseases Center, U. S. Public Health Service, collaborated in addi-

tional studies of the psychrophilic coliforms. These were chiefly *Aerobacter* strains, and as a group tended toward anaerogenous lactose fermentation and strong proteolytic activity. The majority, 36 in number, formed a rather homogeneous subgroup, apparently an aberrant form of *A. cloacae* deviating notably in producing alkaline proteolysis in litmus milk, rapid gelatin liquefaction, and slight, delayed and anaerogenous lactose fermentation. Their IMViC pattern was - - / / at 25° and - / - / at 37°. Despite atypical lactose fermentation, these cultures developed typically on coliform plating media at 25° or 37°.

Generation times for a selected strain of *Pseudomonas fluorescens* were 4.9 hours at 4°, 1.0 at 20° and 1.1 at 32°. Oxygen uptake on glucose substrate by resting cells grown at 4°, 20° or 32° was determined by conventional respirometric techniques at 4°, 20° and 36°. Cells grown at 20° had higher activity at all measurement temperatures than cells grown near extremes of the growth range.  $Q_{10}$  values for oxygen uptake were markedly higher over the 4-20° than the 20-36° temperature range. Disappearance of exogenous glucose was shown by chemical analysis, but the stoichiometry of the relation between glucose and oxygen is not clear. With varying glucose concentrations, the molar ratios of oxygen to glucose under different experimental conditions were not constant but clustered around 1.8, 3.0 and 4.1. Also, while  $Q_{10}$  values for glucose disappearance were analogous in pattern to those for oxygen uptake they were lower in all instances. These results point to the possibility that the relation between oxygen uptake and glucose is not simple and direct.

Microfilm \$2.50; Xerox \$8.60. 190 pages.

## BIOLOGY — GENETICS

A PHENYLALANINE-TYROSINE-DEFICIENT  
STRAIN OF *NEUROSPORA CRASSA*,  
ISOLATED BY FILTRATION ENRICHMENT

(L. C. Card No. Mic 59-257)

Robert Warren Colburn, Ph.D.  
Stanford University, 1958

*Neurospora* biochemical mutants were produced using a modified filtration enrichment technique with the microconidial strain of *Neurospora*. High yields of biochemical mutants, about 30 per cent, were obtained in the two final test runs.

Screening operations were developed in which only the mutants requiring aromatic compounds and wild types grew. The frequency with which these specific mutant types were obtained was 2.9 per cent. This was added evidence that the filtration enrichment technique developed was efficient. Further, in this case in which the mutants recovered in a particular class were closely examined, a wide variety of mutants were represented. Mutants were found which required both phenylalanine and tyrosine (pt) and they were selected for genetic analysis and biochemical study.

By genetic means, a strain was obtained which carried

the pt locus and which crossed well, although the initial pt strains were almost sterile. A single gene difference was found to give rise to the pt phenotype and data are presented indicating that pt is on chromosome IV, approximately 3.9 units distal to colonial-4 (70007).

Biochemical studies showed that pt accumulates several compounds. Evidence for the accumulation of anthranilic acid, a compound with p-aminobenzoic acid growth factor activity, shikimic acid and dehydroshikimic acid was found using chromatographic and bioautographic techniques. An additional compound was found when pt was grown at pH 7.0 and it was isolated. Evidence that the isolated compound was prephenic acid is reported. These findings are discussed in relation to the biosynthetic pathways leading from shikimic acid to phenylalanine and tyrosine in *Neurospora*.

Microfilm \$2.00; Xerox \$4.00. 74 pages.



# PURIFICATION OF CIRCULIN A AND PRELIMINARY STUDIES

(L. C. Card No. Mic 58-3185)

Jesse Leroy Parsons, Ph.D.  
Purdue University, 1958

Major Professors: Henry Koffler and P. A. Tetrault

Circulin, a peptide antibiotic produced by strain Q19 of *Bacillus circulans*, was discovered by Murray and Tetrault in 1948 (*Proc. Soc. Am. Bacteriol.*, 1, 20). It is especially active against various genera of gram negative bacteria and in this respect, as well as in its composition, resembles the polymyxin antibiotics.

Peterson and Reineke in 1949 (*J. Biol. Chem.*, 181, 95-108) found that circulin could be separated into several types by column chromatography. They also determined that circulin contained the amino acids 2,4-diamino-n-butyric acid, threonine, and D-leucine, and the fatty acid, 6-methyloctanoic acid, in a molar proportion of 5:1:1:1, respectively. They concluded that circulin was a cyclic peptide and contained no free carboxyl groups, based on titration data and a negative Van Slyke test for carboxyl groups. They also found that approximately half of the amino groups were combined and that the free amino groups were primarily, if not exclusively, the gamma amino groups of the 2,4-diamino-n-butyric acid. They also prepared several derivatives of circulin such as the formyl, acetyl, dinitrophenyl, and the picrate, helianthate, reinekate, hydrochloride, and sulfate salts. The acetyl and dinitrophenyl derivatives were biologically inactive. They concluded that, since lipase and alkali inactivated circulin, the fatty acid was probably joined in ester linkage to threonine. Since then Nash (Dowling et al., *Science* 116, 147-148), and later Grady, Koffler, and Tetrault (Grady, Ph.D. Thesis, Purdue University), have separately demonstrated the presence of isoleucine; furthermore, the latter workers have shown that threonine is present in a 2:1:1 molar relationship to leucine and isoleucine, and that there are 6 molecules of 2,4-diamino-n-butyric acid. Two of the circulin types separated by column chromatography are major components in the mixture of circulins, and have been designated circulins A and B by Dowling, Koffler, Reitz, Peterson, and Tetrault (*Science* 116, 147-148).

In this research it was found that circulins A and B, when used separately for column chromatography, were partially converted to the other type. This was especially true of circulin B. The process of conversion of circulin hydrochloride to the picrate and back again to remove the citrate buffer, resulted in more extensive conversion. This was true also if heat was used to dry the butanol fractions of circulin B.

Titration of circulin with standard alkali indicated the presence of 5 free amino groups based on the hydrochloric acid removed from the free amino groups. These titrations demonstrated that circulin was not inactivated by alkali as previously thought. These differences in circulin's stability to alkali may be explained by the fact that circulin as the free base is rather insoluble in water and as such may be biologically inactive, and after reconversion to the hydrochloride, it becomes water soluble and biologically active. This alkali stability provides evidence that the 6-methyloctanoic acid is not present in ester linkage.

Treatment of intact circulin A with Edman's phenyliso-

thiocyanate reagent for release of terminal amino acids, gave no release even when the reaction was performed with time, temperature, and strength of hydrochloric acid as variables. These results indicate that circulin does not have a terminal or side chain of amino acids, and provides additional evidence that circulin is a cyclic peptide.

Circulin A, partially hydrolyzed by concentrated hydrochloric acid at 60 C for 2 hours, was broken down into several peptides as well as some free amino acids. The pattern of peptides and amino acids obtained by paper chromatography of the partial hydrolysates of circulins A and B was the same which indicates that the amino acid sequence in these two circulins must be similar if not identical.

Four peptides were isolated from the partial hydrolysate of circulin A by paper chromatographic procedures. The 6-methyloctanoic acid was not released during the procedure and it was thus considered to be attached to one of the circulin fragments. On paper chromatography, peptides #1, #2, and #3' moved between the origin and the 2,4-diamino-n-butyric acid in the order shown with #1 being the slowest. One peptide designated #8' moved the fastest of all, even faster than isoleucine and leucine.

Complete hydrolysis of these four peptides, followed by ether extraction and paper chromatography of the ether residue (made alkaline with ammonium hydroxide), showed that the 6-methyloctanoic acid was present only in #8' peptide along with 2,4-diamino-n-butyric acid. These findings, including the stability of circulin to alkali, show that the fatty acid is attached to one of the diaminobutyric acid molecules and not to threonine.

Complete hydrolysis of the four peptides and determination of the amino acids and fatty acid released, gave the compositions as shown in the table below. The similarity of #3' and #8' peptides to Grady's #3 and #8 should be investigated further.

## COMPOSITION OF ISOLATED PEPTIDES

Peptide	DABA <sup>1</sup>	Threonine	Isoleucine	Leucine	6-MOA <sup>2</sup>
#1	+	+	-	-	-
#2	+	+	-	-	-
#3'	+	+	+	+	-
#8'	+	-	-	-	+

1 2,4-diamino-n-butyric acid

2 6-methyloctanoic acid

+ present

- absent

Microfilm \$2.15; Xerox \$7.60. 163 pages.



THE RELATIONSHIP OF YIELDING ABILITY  
TO DRY MATTER ACCUMULATION AND ITS  
DISTRIBUTION FOR SEVERAL VARIETIES OF  
DRY BEAN, *PHASEOLUS VULGARIS* L.

(L. C. Card No. Mic 59-698)

Donald Howard Wallace, Ph.D.  
Cornell University, 1958

As a possible aid toward breeding for higher yields, an attempt was made to determine if differential yielding ability of dry bean varieties could be ascribed to: (1) initial seed or embryo size, (2) relative growth rate during germination, (3) net assimilation rate, (4) leaf area, (5) the distribution of dry matter among the organs of the plant.

The dry weights of the aerial shoot and its organs (stem, leaf, and fruit) were followed through one to four seasons for each of seven varieties. There were two varieties of differing yielding ability within the marrow type, two within yellow eye, two within the pea type, and one of red kidney type. At maturity the fruit dry weights were further subdivided into fractions representing seed and pod wall. These data were used to estimate net assimilation rate, leaf area, and distribution of dry matter.

Significant varietal differences in leaf area were found both within and between types. Significant differences in net assimilation rate were observed only between types, although there was evidence for differences between varieties of the same type. Within each type, the variety with the higher leaf area most frequently had the higher yields. The varieties differed in leaf-area ratio (leaf area divided by total dry weight). The results of partial defoliation suggest that leaf area may sometimes be present in excess and actually draw upon rather than enhance the dry matter supply.

The varieties differed in the percentage of dry weight at maturity that was present as fruit, and as seed and pod wall. The marrow strain 7-16, which yields about one-fourth more than the variety Perry Marrow and which out-yields all varieties grown commercially in New York, has a very high proportion as seed. About one-half of this yield advantage results from the high proportion of the fruit that is seed, a very low proportion of the fruit being pod wall. The rest of the advantage is expressed through a relatively high number of pods or through large seed size, depending upon the variety comparison being made, and its physiological basis is not clear.

Dry weight changes of the embryo axis were followed through germination for three varieties. The variety with the larger initial embryo axis was found to have a lower relative growth rate during germination with a resultant smaller seedling size; there was not good evidence that either of these factors contributed to the yield differences.

Seed of two or three different sizes was used for some plantings. Seed size significantly influenced the dry weight of seedlings but had no ultimate influence upon yield.

Circumstantial evidence was obtained to support the hypothesis that some of the yield advantage of 7-16 may be acquired through a greater translocation of dry matter from the leaves just prior to their abscission at maturity.

Inverse relationships between net assimilation rate and

leaf area suggest that little is to be gained from using either as a selection index in breeding for higher yields. It should, however, be to the plant breeder's advantage to know the relative level of these factors for the lines used as parents, since segregation may give favorable recombinations with consequent higher yields. Nevertheless, it will be cheaper and easier to base selection on actual yields rather than on leaf area or net assimilation rate.

It is concluded that yield gains might be achieved through breeding for higher proportions of total dry matter as fruit and for higher proportions of the fruit as seed.

Some suggestions are given for further physiological investigation of differential yielding ability.

Microfilm \$2.00; Xerox \$6.40. 133 pages.

IDENTIFICATION OF FREE AND BOUND  
AMINO ACIDS IN THREE STRAINS OF  
*TETRAHYMENA PYRIFORMIS* (EHRENBURG)  
FURGASON, USING PAPER CHROMATOGRAPHY

(L. C. Card No. Mic 58-5187)

Ouida Carolyn Wells, Ph.D.  
Emory University, 1958

The free and bound amino acids of three strains of *Tetrahymena pyriformis* (Ehrenberg) Furgason were identified in this investigation. Amino acids and fluorescent substances in each of the three strains were studied with the technique of filter paper chromatography. One-dimensional and two-dimensional chromatograms were used in this study. Amino acid patterns were revealed by the ninhydrin reaction; fluorescent patterns were observed with the aid of ultraviolet light having a maximum transmission of 3600 Angstrom units.

Bound amino acids were released from the protoplasm of each strain by the following three types of hydrolysis: (1) 6N HCl for 24 hours at 110° C in vacuo, (2) 6N HCl for 48 hours at 110° C in vacuo, (3) 5N NaOH for 6 hours at 110° C in vacuo. Twenty amino acids were identified from hydrolyses of each strain; no quantitative or qualitative differences in bound amino acid patterns were observed among the strains.

Free amino acids were analyzed by applying samples of unhydrolyzed members of each strain to separate sheets of chromatography paper. Seventeen free amino acids were identified in common for each strain. Although no qualitative differences were observed among the strains, certain quantitative variations were noted. Qualitative differences among the strains were observed on fluorescent chromatographic patterns.

Paper chromatography was found to be a satisfactory method for the detection of strain-specific biochemical and physiological differences which may characterize diverse strains of *Tetrahymena pyriformis*. Differences in the amino acid patterns reported in this investigation and those detected by other investigators for different strains and species were noted and discussed.

Microfilm \$2.00; Xerox \$4.00. 71 pages.



## BOTANY

### THE REVERSIBLE PHOTOREDUCTION OF CHLOROPHYLL

(L. C. Card No. Mic 59-467)

Thomas Turpin Bannister, Ph.D.  
University of Illinois, 1958

In oxygen-free pyridine solutions of chlorophyll a and ascorbic acid, pink photoreduced chlorophyll arises rapidly only when polar solvents, such as water or alcohol, are added to induce the formation of the ascorbate anion, the effective electron donor. The quantum yield of the formation of pink reduced chlorophyll increases approximately linearly with water content from a value of zero in dry pyridine to a value exceeding 0.05 in 40% aqueous pyridine. Hydrogen ions, formed in aqueous pyridine by the dissociation of ascorbic acid, react with pink reduced chlorophyll to form blue-gray reduced pheophytin a; the latter also arises directly when oxygen-free, aqueous pyridine solutions of pheophytin a and ascorbic acid are irradiated. In the dark, reduced pheophytin generates pheophytin. If the hydrogen ion concentration in aqueous pyridine solutions is reduced by adding part of the reductant as sodium or calcium ascorbate, the conversion of pink photoreduced chlorophyll into photoreduced pheophytin is retarded sufficiently to permit the formation of pink solutions.

In irradiated, oxygen-free, ethereal solutions of chlorophyll and phenylhydrazine, pink reduced chlorophyll is formed without subsequent pheophytinization, but the quantum yield of photoreduction - about .003 - is small. In this system, the reaction is essentially reversible - i.e. chlorophyll is regenerated in the dark. Photoreduced chlorophyll is formed in several other solvents as well.

Absorption spectra of photoreduced chlorophyll and photoreduced pheophytin were obtained by measuring the absorption of bleached solutions in photostationary states. These spectra, compared to those previously published, are less distorted by the presence of unreduced chlorophyll and cover the visible spectrum more completely. Ethereal solutions of pink reduced chlorophyll have absorption maxima at 410 and 520 mμ; pyridine solutions of blue-gray reduced pheophytin have maxima at 370, 530, and 620-640 mμ.

Pink reduced chlorophyll is not paramagnetic, a fact which indicates that it is a fully (twice) reduced derivative. The pink derivative does not arise in a reaction between the reductant and chlorophyll in the singlet excited state nor, probably, in the excited triplet state. The Russian studies of polymerization initiation, photoconductivity, and photopotential, and the author's study of the dependence of the quantum yield of photoreduction on the concentration of reductant, indicate that the pink derivative arises from a more labile, more actively reducing primary photoproduct. The primary photoproduct may arise by the excitation of a chlorophyll-reductant complex - a mechanism suggested by Livingston to account for the chlorophyll-sensitized reduction of dyes.

The chlorophyll-sensitized reduction of safranin T by ascorbic acid in aqueous pyridine proceeds too rapidly to be explained as an oxidation of pink reduced chlorophyll by safranin. Probably a more actively reducing precursor of the pink derivative mediates safranin reduction. The precursor could be a semiquinone radical and may be the same agent which mediated the sensitized reductions of dyes studied by Livingston.

In photosynthesis (assuming a photoreduction of chlorophyll to be the primary process) as in the chlorophyll-sensitized reduction of safranin in solution, the stable, fully reduced pink derivative of chlorophyll is unlikely to be a more important reducing agent than is a more labile, partially reduced precursor. A comparison of the difference absorption spectrum of illuminated *Chlorella* suspensions with the difference spectrum of the photoformation of pink reduced chlorophyll fails to implicate the latter in photosynthesizing cells. At photosynthesis-saturating light intensities, however, the active reduced chlorophyll derivative might be formed faster than it could be used in photosynthesis; under these conditions the pink derivative could accumulate as a side product.

Microfilm \$2.00; Xerox \$6.60. 139 pages.

### THE FREQUENCY OF CHROMOSOMAL ABERRATIONS FOLLOWING A LOW DOSE OF X RADIATION

(L. C. Card No. Mic 58-5117)

Anita Ilese Bolinger, Ph.D.  
Emory University, 1957

The effects of 50 r of X radiation on the induction of chromosomal aberrations in the microspores of *Tradescantia paludosa* were studied. A series of experiments designed to test the sensitivity of the chromosomes to a low dose of X radiation given at various intensities in air and in an 80 per cent carbon monoxide-20 per cent oxygen mixture was performed.

A study of spontaneous aberration frequency indicated that none of the conditions under which the plants were grown, or to which they were subjected, during the course of the investigation affected the spontaneous aberration rate; thus, any increase in the aberration frequency could be attributed to the effects of X radiation.

There was a gradual increase in the aberration frequency following exposures in air to intensities ranging from 0.50 r to 100 r per minute. When higher intensities of 200 r and 400 r per minute were used, the aberration frequency was decreased to the level observed at 4 r per minute. An explanation for this decreased frequency at higher intensities is not readily available; however, the explanation may lie in a physiological effect of a low dose given at high intensities which favors restitution over reunion.



A threshold intensity for delivering the dose was not reached since an intensity of 0.25 r per minute increased the aberration frequency over the spontaneous rate.

Control experiments designed from the methods of calibration of the X-ray unit for the various intensities used indicated a difference in the biological effectiveness of X rays from 250 kv filtered by copper and by aluminum, since a total of 50 r filtered through copper was much less effective in inducing chromosomal aberrations than was the same dose filtered by aluminum.

The effect of a carbon monoxide inhibition of cytochrome oxidase in increasing aberration frequency reported by other investigators was not observed following treatment with intensities of 1 to 100 r per minute. An increase in aberration frequency above that found in air at intensities of 200 r and 400 r per minute is not explained. If this response is considered to be the result of an inhibition of cytochrome oxidase, which ordinarily releases energy for restitution, then intensity has a differential effect on this inhibition when low doses are used. If the lack of effect at low intensities is attributed to an anaerobic system which supplies enough energy for restitution at low dose rates, then at higher intensities and doses more breaks are present simultaneously than the cell can provide energy for restitution. The breaks are then held open long enough to favor reunion over restitution.

The use of an arbitrary measure of breaks per cell as an attempt to establish a common denominator for low aberration frequencies supported previous conclusions.

A differential sensitivity of the microspores of *Tradescantia paludosa* to a low dose of X radiation given under various experimental conditions has been found.

Microfilm \$2.00; Xerox \$6.40. 133 pages.

#### STUDIES ON THE ECOLOGICAL LIFE HISTORY OF *PORTULACA SMALLII* P. WILSON

(L. C. Card No. Mic 58-5126)

David James Cotter, Ph.D.  
Emory University, 1958

*Portulaca smallii* P. Wilson, a small succulent annual, is endemic to the granite outcrops of the Piedmont section of the southeastern United States. Its life cycle was studied in the field by direct observations and in the laboratory by controlled experiments emphasizing the response of the plant to single factors.

The granite outcrops are located in the Piedmont in semi-isolated groups forming a chain from southern Virginia to eastern Alabama. *P. smallii* characteristically grows in a narrow band of soil in the ecotone between the exposed granite surface and the marginal outcrop vegetation, but is found frequently in the rock rubble from past quarrying operations and occasionally in the other habitat areas of the outcrop. The distribution of *P. smallii* throughout its range appears to be fortuitous. It is a strict endemic of the granite outcrops and there is no indication of extending its range at present.

The environment of these outcrops is extreme and in sharp contrast to the surrounding areas. Weekly environmental measurements made during the summer of 1956 on Mount Arabia indicated the extreme variation in the soil

moisture content within the habitat of *P. smallii* and temperature differences of 8° C between the outcrop and the surrounding area.

*P. smallii* germinates in the early summer, the first flowers appear about one month after germination, and fruits with mature seeds a week later. Flowering continues through the growing season and is followed by a senescent period marked by decreased physiological activity and tolerances. The height of flowering occurs about mid-August and death to the majority of the plants by mid-November. The phenology varies from year to year on the basis of the differences in climate, and in a single season due to differences in the microenvironment and genetic characters among the members of a population. Permanent quadrats were used to supplement observations on phenology.

Germination is controlled by an impermeable seed coat. There is no after-ripening period necessary for the embryo and seedlings were available at any time if the testa was ruptured. Establishment is the most critical phase of the life cycle, and an adequate supply of moisture is essential for future vigor and development. After the plants become established, they develop wide tolerances to moisture conditions.

Observations on the morphology of *P. smallii* in 12 different outcrop populations revealed a wide variation in the structure of *P. smallii* beyond the limits described by Wilson. Often within the same population, and even on the same plants, there were some flowers which fit the described limits of *P. smallii* and others which fit the description of *P. pilosa* L. A genetic control of floral morphology was evident since flowers on the same plant and cuttings of plants placed in different environmental conditions revealed an indefinite non-patterned variation and failed to demonstrate any environmental modification of the floral characteristics of the plant. The vegetative and physiological variations observed are controlled by both the innate genetic characters of the plant and the environment. *P. smallii* appears to merit a specific rank, but it is closely related to *P. pilosa* and there is an overlap in the characteristics which distinguish them.

*P. smallii* appears to be well adapted to its environment. The requirement of high light intensities, the need for freedom from competition, and its tolerance to high temperatures and extreme moisture conditions account for its ability to live under the extreme outcrop conditions, and also restrict it to the habitat. Other factors which are significant in its growth are a photoperiod which insures flowering with decreasing day length, the self and cross pollinated flowers, and the lack of a specific adaptation for seed dispersal. Microfilm \$2.00; Xerox \$5.00. 98 pages.

#### THE ETIOLOGY OF TOBACCO ANTHRACNOSE

(L. C. Card No. Mic 59-143)

Eunice Allene Thompson Cronin, Ph.D.  
Duke University, 1958

Supervisor: T. W. Johnson, Jr.

Investigations were carried out in the following three areas, included under the broad heading of etiology of



tobacco anthracnose: (1) taxonomy of the causal organism; (2) penetration mode and pathway; and (3) the histological pathology of the disease.

The causal fungus was assigned to the species *Colletotrichum destructivum* O'Gara on the basis of comparative morphology, from pure cultures growing on a standard chemically defined medium, and on pathological studies. *Colletotrichum nicotianae* Averna-Sacca, *C. tabacum*, Böning, and *Gloeosporium nicotianae* Böning are synonymous with *C. destructivum*.

Penetration by the fungus into the intact host tissues, determined by observations on sectioned and stained infected leaf and petiole material, was accomplished by secondary spores, appressoria. These pre-infection cells produced infection pegs which penetrated tobacco epidermal cells. Subsequent to penetration, large, irregular fungal cells, primary mycelium, were formed. Invasion of the adjacent cells was accomplished by slender hyphal filaments formed from the elongation of the primary mycelium.

The pathological effects apparently preceded invasion by the fungal growth and were attributed to the diffusion of toxins from the infection site. Consistency in shape and size of anthracnose lesions, together with the absence of fungal filaments in living cells at the periphery of the lesions, indicated a host reaction to the infection.

The host ranges of *Colletotrichum destructivum* isolates from tobacco and legumes, and 15 related *Colletotrichum* species were investigated. Results showed similar host ranges for the four *C. destructivum* isolates, and indicated that *Colletotrichum* species causing anthracnose are not highly specialized in their host requirements.

Microfilm \$2.00; Xerox \$3.80. 67 pages.

#### ECOTYPIC VARIABILITY OF *TSUGA CANADENSIS*: PHOTOSYNTHESIS AND RELATED PROCESSES

(L. C. Card No. Mic 59-996)

Hugo Alfred Ferchau, Ph.D.  
Duke University, 1959

Supervisor: Henry J. Oosting

Seedlings of ecotypes of *Tsuga canadensis* were grown in the field and under greenhouse or controlled conditions. The seedlings in the field were used to determine seedling survival and the influence of photoperiod under local conditions, shoot-root and related ratios, and variations in chlorophyll content. Plants grown indoors were used to determine variability in the rate of photosynthesis and respiration as related to several environmental factors. Measurements of photosynthesis and respiration were made with a Beckman infra-red gas analyzer which was part of a closed system.

Field studies indicated that under local conditions, if seedlings are not too small, hemlock may grow well. Extended daylength tends to increase the growth of all geographic races used in the study. Representatives of nearly all sources have a shoot-root ratio greater than 1.

The amount of chlorophyll present in the needles is related to the environmental conditions to which hemlock is subjected, rather than geographic origin. Under field conditions, hemlock has a lower chlorophyll content than many

other vascular plant species which have been examined. Chlorophyll in seedlings grown in the greenhouse tends to compare favorably with that of other species. Lowest chlorophyll content tends to be associated with low light intensity (500 f. c.) when the temperature is between 75° F. and 80° F. The ratio of Chlorophyll A to Chlorophyll B is consistent at 1.3, which indicates a relatively lower Chlorophyll A content for hemlock than for most other species.

Two geographic races originating from Gatlinburg, Tennessee and Wanakena, New York, were used in the photosynthesis and respiration experiments. The peak for photosynthetic efficiency was at a higher light intensity for the ecotype from Tennessee than for the ecotype from New York. Environmental conditioning causes variation in the photosynthesis curve. Tennessee seedlings grown in a constant temperature room have a peak of photosynthetic efficiency at a lower light intensity than those grown in the greenhouse. There is a marked decrease in the rate of photosynthesis associated with dormancy.

Microfilm \$2.00; Xerox \$3.80. 66 pages.

#### THE PRODUCTION OF CHROMOSOME ABERRATIONS IN THE MICROSPORES OF *TRADESCANTIA* *PALUDOSA* BY CONTINUOUS AND FRACTIONATED X-IRRADIATION IN ATMOSPHERES OF HELIUM, AIR, AND OXYGEN

(L. C. Card No. Mic 58-5140)

Robert Henry Fetner, Ph.D.  
Emory University, 1955

The microspores of *Tradescantia paludosa* were given continuous X-irradiation of 200 r and 400 r and fractionated irradiation with two equal 200 r doses separated by hourly intervals of 0-10 hours between dose fractions. All irradiations were given at 50 r per minute with 250 KV and 15 MA and at 30° ± 0.5 C. The inflorescences were maintained at 30° ± 0.5 C and under constant illumination during the post-irradiation five-day interval. The chromosome interchange and deletion frequencies were determined by scoring 500 cells from propionic-carmin preparations of the microspores.

With increased amounts of atmospheric oxygen present during irradiation there were a greater number of chromosome aberrations produced. In 21% oxygen there were 2.7X as many interchanges and 1.4X as many deletions as with irradiations in atmospheres of helium. In 100% oxygen 3.6X as many interchanges and 1.8X as many deletions were produced as with the same irradiation in an atmosphere of helium. Chromosomes irradiated in an atmosphere of helium had twice the reunion activity (deletions/interchanges) of those irradiated in the presence of atmospheric oxygen.

As a result of the fractionation experiments, it was found that the damage produced by the first dose remained available for interaction with the second dose for at least seven hours with irradiation in atmospheres of helium, nine hours with irradiation in atmospheres of air, and ten hours with irradiations in atmospheres of pure oxygen. These data indicated that there was not a rapid reunion of radiation damage. The differences in aberration frequencies found with successive hourly intervals between doses, in those irradiations given in atmospheres of air, provide a



possible explanation of the discrepancies in the reports of other investigators who did not use as frequent intervals between dose fractions.

Microfilm \$2.00; Xerox \$5.00. 96 pages.

**BIOLOGY AND CONTROL OF THE ONION  
BLOAT NEMATODE, DITYLENCHUS DIPSACI  
(KÜHN) FILIPJEV**

(L. C. Card No. Mic 59-975)

Gwynne David Lewis, Ph.D.  
Cornell University, 1958

**PART ONE. OVERWINTERING AND MIGRATION OF  
DITYLENCHUS DIPSACI (KÜHN) FILIPJEV IN ORGANIC  
SOILS OF SOUTHERN NEW YORK**

The overwintering and migration of *D. dipsaci* in the organic soils of southern New York were studied by sampling infested fields at approximately 3-week intervals for 2 years. It was shown that this species overwinters in the soil mainly as adults and preadult larvae. A few earlier stage larvae were found but eggs were not. Studies on migration were conducted by sampling the soil at 2 levels, 0-6 in. and 6-15 in. It was shown that a partial downward migration occurred in the fall, and a partial upward migration occurred in the spring. The rate of mortality was high in the portion of the soil that became frozen in the winter. It was found that individuals of this species can persist in the soil in the absence of a susceptible crop for at least 2 years.

**PART TWO. CHEMICAL CONTROL OF DITYLENCHUS  
DIPSACI (KÜHN) FILIPJEV IN ORGANIC SOILS OF  
SOUTHERN NEW YORK**

Organic soils used for onion culture in southern New York and infested with *D. dipsaci* were fumigated with D-D (a mixture of 1, 2-dichloropropane and 1, 3-dichloropropane) at rates of 50 or more gal./acre. All treatments resulted in excellent control. No infected onions were found in the treated fields in the 2 years following the fumigations. No injury resulted to the following onion crops even with a total rate of 110 gal./acre.

**PART THREE. TEMPERATURE AND MOISTURE IN  
RELATION TO THE TOXICITY OF 1, 3-DICHLOROPRO-  
PENE TO DITYLENCHUS DIPSACI (KÜHN) FILIPJEV IN  
ORGANIC SOIL**

A method was developed in which percentage mortality of nematodes is obtained following the fumigation of infested soil in 1-gal. glazed crocks. Using this method, it was demonstrated that the efficacy of D-D (a mixture of 1, 2-dichloropropane and 1, 3-dichloropropane) against *D. dipsaci* in organic soil is directly related to soil temperature and inversely related to soil moisture. Soil temperatures of 40°, 60°, and 80°F and soil moistures of dry (near the point of permanent wilting), medium (approximately suitable for planting seed), and wet (near field capacity) were used in the comparisons. A comparison of D-D with Telone (technical dichloropropenes) indicated that approxi-

mately 3 parts of D-D are required to give the same mortality obtained from 2 parts of Telone.

Microfilm \$2.00; Xerox \$3.00. 46 pages.

**MICROBIAL ASSOCIATIONS IN THE  
FUSARIUM ROOT ROT OF BEANS**

(L. C. Card No. Mic 59-687)

Otis Cleo Maloy Jr., Ph.D.  
Cornell University, 1958

The dry root rot of beans, caused by *Fusarium solani* f. sp. *phaseoli*, is an important disease in the major bean growing areas of the world, but adequate control measures are lacking. Soil fungicides have not been proven to be economically feasible and resistant horticultural varieties are not available. Partial control is accomplished by cultivation and irrigation practices, and by crop rotation. Despite the extensive use of various rotations, little is known of the value of different crop sequences, of the length of rotations, or of a number of other factors that may be affected by different crop residues. The development of a crop rotation program that would successfully reduce losses resulting from the dry root rot of beans requires a more complete knowledge of the effects of the various rotations employed in bean growing areas on pathogen and other microbial populations in the soil, on the development of root rot severity, and on the microorganisms associated with the roots of bean plants and their relation to the age and condition of these roots.

No marked differences in populations of the bean root rot pathogen, *F. solani* f. sp. *phaseoli*, were found in bean fields having different cropping histories in regard to type of crop grown and to the length of the rotation. Pathogen development from extremely low quantities of inoculum, i.e., 1 spore per g. of soil, was found to result in as high as 100 per cent incidence of infection. No relationship was observed between the prevalence of certain nutritional groups of bacteria and severity of root rot. Nematodes did not appear to be important in facilitating the initiation or intensification of root rot of bean. Differences in bean root rot severity may be due in part to the activities of secondary invaders after infection by *F. solani* f. sp. *phaseoli*, since populations of the pathogen were lower in soils where root rot was severe than in soils where root rot was moderate. Data on top growth of greenhouse-grown plants indicates that alfalfa crop residues have a toxic effect on bean plants. The severity of root rot on beans immediately preceded by wheat was considerably lower than on beans preceded by other commonly employed rotation crops.

Three potentially pathogenic fungi were found on or in bean roots in a microscopic study of roots at various times after planting and in or on roots from soils with different histories of cropping or addition of amendments. The frequency of occurrence of some of these fungi and of nematodes appeared to follow definite trends in relation to age of the roots, although environmental factors may have been involved. Both qualitative and quantitative differences were found in the types of fungi in bean roots grown after various plants or in soil amended with manure or sawdust in field and greenhouse experiments.



The fungi isolated from bean roots generally were different from those found by microscopic examination. *Fusarium oxysporum* was the most commonly isolated fungus. The fungi isolated from bean roots at various times after planting were grouped on the basis of their utilization of carbon materials of differing complexity. The fungi isolated during the early sampling periods utilized only glucose and other simple sugars. On a comparative basis, those isolated at intermediate times utilized cellulose, in addition to glucose, and those isolated at the later sampling times utilized lignin, cellulose, and glucose. The severity of root rot induced by mixtures of 4 root rot fungi was not significantly greater than the root rot induced by *F. solani* f. sp. *phaseoli* alone. The distribution of fungi in root rot lesions was markedly specific; and root rot pathogen was isolated least frequently from the margin of lesions whereas *Alternaria* spp. were isolated most frequently from the margin. The other fungi followed similar distribution patterns. Also, there were differences in the frequency of isolation of various fungi from plants in different stages of maturity.

Root rot is less severe in beans following certain non-host crops than on beans following beans, but the populations of the root rot pathogen is comparable in the 2 cases. Therefore, a comparative study of the physiology of the mycelial (M) and conidial (C) types of *F. solani* f. sp. *phaseoli* was made in an effort to determine if this lack of association between populations of the pathogen and disease severity were due to conversion of the pathogen to the less pathogenic, mycelial type. Root extracts from wheat and alfalfa plants, whose use in rotation had resulted in low severity of root rot, selectively stimulated the mycelial type. The M-type of the pathogen produced greater growth on a larger number of the carbohydrates tested than did the C-type. The M-type tolerated a greater number of antibiotics and higher antibiotic concentrations than did the C-type. The M-type became predominant in soil under conditions of limited nutrient availability.

Microfilm \$2.00; Xerox \$7.00. 149 pages.

#### A FLORESTIC SURVEY OF THE SEVERN RIVER DRAINAGE BASIN OF NORTHWESTERN ONTARIO

(L. C. Card No. Mic 59-1282)

David Ross Moir, Ph.D.

University of Minnesota, 1958

Adviser: Gerald R. Ownbey

Although many recent works are available on the floristics of boreal North America, there still remain some remote interior tracts in which little or no botanical investigation has been undertaken. One such area is the Severn River drainage system of northwestern Ontario, which is the location of this investigation. During the course of several seasons of field work covering representative portions of the drainage, vascular plants have been collected and identified, and related data on the physiography, glacial features, soils and plant community structure have been collected and assembled.

The Severn River drainage system is approximately 250 miles in length, and comprises some 40,000 square

miles of area. It has its headwaters in the pre-Cambrian zone of northwestern Ontario and flows generally in a northeasterly direction through the Hudson Bay Lowlands, which lie between the Laurentian Upland province and the Hudson Bay Coast. In this transect there is great variety in the land forms, which is reflected in the vegetative cover. The forest cover ranges from well developed spruce-fir forests in the southern portion, through a broad zone of stunted spruce muskeg and lichen woodland to a narrow fringe of tundra-like cover in the immediate coastal area.

This report includes a review of the literature, both botanical and geological, pertinent to the area, and representative physiographic features from the headwaters to the mouth are described. One section is devoted to a discussion of the regional glaciation, glacial depression and postglacial uplift, with their resulting landforms.

Subsequent sections describe the soils, climate, and vegetation. Representative communities of the major types are described in sequence from the southern portion of the drainage to the coast, with numerous illustrations.

The vascular plants are listed in the annotated catalogue. For each species the collection locality, habitat data and collection number are cited, with a subjective evaluation of abundance. Other known collections from the area are included. The catalogue, consisting of some 600 species is based on approximately 4000 cited specimens.

Microfilm \$3.45; Xerox \$11.80. 267 pages.

#### ECOLOGY OF WINTER SNOW-FREE AREAS OF THE ALPINE TUNDRA OF NIWOT RIDGE, BOULDER COUNTY, COLORADO

(L. C. Card No. Mic 59-833)

William Sherman Osburn, Jr., Ph.D.

University of Colorado, 1958

Supervisor: Associate Professor John W. Marr

An intensive study of selected stand ecosystems of the alpine tundra on Niwot Ridge, Boulder County, Colorado, was made in 1956 and 1957, following five years of general field work in the alpine tundra of this and other areas in the Rocky Mountains. The selected units were representative of major tundra types found elsewhere in Colorado.

Regional environment and the following stand features were studied most intensively, plant species presence and cover, animal species presence and role in stand dynamics, seasonal snow cover, soil profile, and soil moisture.

Four stands occurring in winter snow-free areas which appeared to be related to one another were selected for this paper. The dynamics of these four landscape units demonstrates a successional trend in the alpine tundra.

The strong winter winds blow some areas free of snow and deposit it in other areas and thereby profoundly affect soil water in each stand. In late spring, when the wind velocity is reduced, the entire tundra is mantled with snow. When this snow melts, soil water is abundant, but the soil gradually dries out until the mid-July and early August rains, when soil moisture again becomes abundant.

The amount of humus in the upper soil horizons controls the location of water concentration in the soil. Proportionally,



the more humus in the top soil horizon the more moisture is absorbed and less penetrates to lower horizons.

Cushion plants with their long taproots dominate if the moisture is concentrated in the lower horizons. Fibrous rooted plants are favored if the moisture is largely confined to the upper soil horizons.

As the trend of soil development is to increase the depth of the humus in the A horizon, plants which most effectively utilize the upper soil horizons will eventually dominate; *Kobresia bellardii* is the species best adapted to this situation. It initiates growth in the early spring when the soil moisture is high and is able to flower and set fruit without any additional moisture. This period of growth and development dries out the humus to a very low moisture percentage; consequently, the humus mat can absorb nearly all of the midsummer rainfall and little moisture percolates below. In this manner *Kobresia* can maintain dominance and long taproot species will be eliminated. Coincident with the midsummer rains, *Kobresia* undergoes maximum vegetative growth, presumably building up its carbohydrate reserve. Consequently, this species dominates the *Kobresia* meadow which is the climatic climax on Niwot Ridge.

Any process which significantly reduces the amount of humus will also alter the plant community and change the type of stand. The combined effects of gopher digging, which kills plants, and the strong wind which blows away humus and fine soil is one of these processes. Plants which best tolerate the results of gopher disturbance and therefore persist during their activities have the following characteristics: upright growth form which will be difficult to cover by mounding over, fibrous roots which are better able to tolerate burrowing than a taproot species and one which is not used as gopher food.

Upon cessation of gopher activity a stand of cushion plants develop and the normal trend to deepen the humus horizon begins anew. Eventually sufficient humus depth is reached to permit *Kobresia* to develop and form the climatic climax.

Under the present climatic regime, the most exposed and windy sites may not build back humus to a depth sufficient for *Kobresia*; in these sites, a topographic climax of cushion plants may persist.

Microfilm \$2.00; Xerox \$5.00. 96 pages.

**STUDY OF RELATIONSHIPS BETWEEN CERTAIN  
TROPICAL SPECIES OF THE *SOLANUM NIGRUM*  
COMPLEX BY STATISTICAL, CYTOGENETIC  
AND SYSTEMATIC PROCEDURES**

(L. C. Card No. Mic 58-7933)

Jorge Alfredo Soria, Ph.D.  
Indiana University, 1958

The *Solanum nigrum* complex of the Morellae section of the genus *Solanum* comprises morphologically quite similar species which has caused some confusion in classification. A comparative study was made of 17 races be-

longing to five diploid and six polyploid species mainly from tropical America.

Two methods were applied to study relationships between species:

(a) A statistical analysis of correlations of 26 characters of each species was made. The correlations were grouped by the "variable group method" and a scheme of relationships between species was derived giving a systematic order on the basis of their morphology. This arrangement showed remarkable agreement with that expected from purely taxonomic procedures. The method proved to be relatively efficient in establishing morphological categories influenced by a minimum of personal opinion and should have wider application in taxonomy.

(b) Attempts to get crosses between the species at all levels of polyploidy were made. There was no manifest genetic barriers impeding crossability between the diploid species, although partial sterility occasioned apparently by the lack of homology of one pair of chromosomes was found. Only two crosses out of 20 attempted at the tetraploid level were secured and they were fertile or partially so. Crosses between species of different ploidy level were made and the resulting hybrids were sterile as expected. The triploid hybrids and haploid plants of *S. nigrum* showed several unusual irregularities at meiosis. Genetically all the diploid species can be considered as members of one highly variable species; but, since they are self-pollinated, have clear morphological differences and are largely geographically isolated, it was decided to consider them as "borderline species".

Doubling of the chromosome complement of some triploid hybrids was obtained both by colchicine treatment and spontaneously. The plants were fertile and showed the morphological characteristics of polyploids.

Microfilm \$2.00; Xerox \$5.60. 114 pages.

**STUDIES ON THE ECOLOGICAL LIFE HISTORY  
OF *DIAMORPHA CYMOSA* (NUTT.) BRITTON**

(L. C. Card No. Mic 58-5189)

Deems Norwood Wiggs, Ph.D.  
Emory University, 1956

An investigation of the life history of *Diamorpha cymosa* (Nutt.) Britton was made during the period May, 1954, to May, 1955. The objective of the study was to determine why *D. cymosa* is limited in distribution to the granite outcrops or similar situations. The life history was approached from the viewpoint of ecology, physiology and morphology, and the species was studied as an individual plant, as a population, and as part of the outcrop community.

Distribution of *D. cymosa* follows closely that of the granite outcrops in the southeastern Piedmont, which occur in an area about 700 miles long and 120 miles wide from North Carolina to Alabama. The area for this study



included four outcrops near Atlanta. The experimental work was conducted in the greenhouse at Emory University.

*D. cymosa* grows mainly in the depressions which dot the granite surface. The plant has a characteristic red pigment which develops in epidermal cells of leaves and stems shortly after germination. The mature plants vary in size, ranging from 2-10 cm tall, with various degrees of branching.

The seeds remain in the capsule on the dead plant from May until late summer and early fall, during which time they undergo an after-ripening process for 70-120 days after maturity. The seeds are released during September, October, and November as the capsules break down, mostly due to action of moisture. Field germination occurs in November when temperatures range around 20°C and moisture is abundant.

Greenhouse experiments on germination showed that a steady temperature of 20°C plus or minus 3°C was the optimum temperature for germination, and that a high degree of moisture was required. The most critical period in the life cycle was during germination and the seedling stage. The force of water as rain and run-off was the chief cause of mortality during the seedling stage.

During December and January, very little growth occurs, the plant assuming a rosette form. Bud primordia appear in February, the inflorescences expand during March, and the flowering period occurs during April.

In the population studies, a correlation was found between soil depth and plant form and density, the deeper soils (5-10 cm) supporting the larger plants and densest populations, with the shallow soils (1-4 cm) supporting small plants in sparse populations.

*D. cymosa* may be the first plant to enter the depression when a thin layer of soil is deposited, but as the

soil becomes deeper and more aggressive species invade, it is unable to compete and survives only at the periphery in concentric circles. In advanced successional stages, *D. cymosa* eventually may be eliminated.

Specific adaptations of *D. cymosa* to the extreme conditions of its habitat are:

- (1) development as a winter annual, with survival over summer in the seed stage,
- (2) retention of the seeds over summer in the follicles of the dead plants, 2-3 inches above the soil surface,
- (3) physiological delay of germination until the following fall,
- (4) resistance to frost,
- (5) capacity of the seedling and juvenile stages to revive after two to three weeks of extreme drought by use of water stored in the succulent leaves,
- (6) ability to survive three to four weeks of inundation,
- (7) an extensive fibrous root system, and
- (8) a delayed release of pollen in four of the eight anthers.

Conditions requisite for survival are high light intensity, freedom from competition, a pH of about 5, a soil adequate for an extensive root system, and adequate moisture during the critical periods of germination and establishment. *D. cymosa* is therefore restricted to the granite outcrops or to other comparable rock outcrops because these habitats are the only ones in this region where this unique combination of factors occurs.

Microfilm \$2.00; Xerox \$6.60. 138 pages.



## CHEMISTRY

### CHEMISTRY, GENERAL

#### ASPARTIC ACID METABOLISM BY AN ENZYME SYSTEM ISOLATED FROM *ESCHERICHIA COLI*

(L. C. Card No. Mic 58-2120)

Fu Ho Chen Chow, Ph.D.  
Colorado State University, 1957

It is well known that aspartic acid is deaminated to form fumaric acid by an enzyme, aspartase, isolated from bacterial cells. It has been proposed that aspartic acid may also be hydrolytically deaminated to produce malic acid and ammonia. However, proof of the existence of an enzyme capable of catalyzing this latter reaction has not been recorded in the literature. The purpose of this study was to obtain more information about enzyme-catalyzed deamination of aspartic acid.

A cell-free extract containing high aspartase activity was prepared from *E. coli* cells by freeze-drying, grinding, and extracting with phosphate buffer. Further purification was achieved by fractionation with ammonium sulfate. This partially-purified enzyme preparation was found to contain aspartase, fumarase, and transaminase but not succinic dehydrogenase.

The kinetic constants (equilibrium constant  $K_c$  and Michaelis constant  $K_m$ ) of the reaction catalyzed by the aspartase in this extract were determined experimentally. The quantitative analysis of aspartate and fumarate was made by means of paper chromatography and spectrophotometric absorption, respectively. At 25°C and pH 7.0 in 0.033 M phosphate buffer,  $K_c = 0.0031$  with aspartate as substrate and  $K_c = 0.0026$  with fumarate as substrate. The Michaelis constant ( $K_m$ ) was found to be 0.02 using fumarate as substrate and measuring rate of reaction by means of aspartate production rather than ammonia decrease.

This aspartase was found to be inhibited by bromide, iodide, tartarate, oxalate, citrate, 1,2-ethanedisulfonate and partially by maleate and malonate at high concentration (0.4 M). No inhibition occurred due to the presence of fluoride or glycine.

Evidence has been obtained indicating the presence in this *E. coli* extract of an unidentified enzyme. The function of this enzyme is to catalyze the reversible hydrolytic deamination of aspartate to yield malate and ammonia. This evidence is as follows:

1. Equilibrium concentrations of fumarate, malate and aspartate in the presence of the enzyme extract were not in accord with known values in the presence of fumarase and aspartase, the only enzymes supposed to be present which were related directly to the metabolism of aspartate. This deviation of the equilibrium concentrations from the theoretical values is of a type which could result from the presence of the postulated hydrolytic deaminase.

2. By suitable modification of the Lineweaver-Burk plot and by proper choice of substrates and inhibitors, it was possible to demonstrate that more than one route

exists by which malate can go to aspartate, and also that there is more than one route by which fumarate can go to aspartate. The new route appears to be passing from malate to aspartate directly.

3. When an inhibitor of fumarase but not of aspartase was used to block the reaction malate  $\rightarrow$  fumarate  $\rightarrow$  aspartate, malate was nevertheless readily converted to aspartate without passing through the fumarate step.

This new enzyme, although not yet isolated, was calculated to have Michaelis constant of 0.02 moles malate, and an equilibrium constant of 0.0099 with aspartate as substrate. Its action was inhibited by glycine, bromide, iodide, citrate, oxalate, D-malate, succinate, and 1,2-ethanedisulfonate; partially inhibited by maleate and malonate at higher concentration (0.4 M) and uninhibited by fluoride and sulfide. Microfilm \$2.00; Xerox \$4.20. 80 pages.

#### POLAROGRAPHY AND CONTROLLED POTENTIAL ELECTROLYSIS OF ORGANIC COMPOUNDS

(L. C. Card No. Mic 58-5170)

Robert M. Powers, Ph.D.  
Emory University, 1958

This research represents an attempt to elucidate the mechanism of electrolytic reduction of carbonyl compounds. In order to reach this end, a systematic polarographic study has been made on various aromatic aldehydes, aromatic ketones, and aliphatic ketones. Since conclusions regarding mechanism made from polarographic data are largely speculative, actual large-scale reductions were performed at carefully controlled cathodic potentials. The products of these macroelectrolyses were isolated and identified. Coulometric measurements were also made to determine the number of electrons involved in the electrode process.

A study was made of various substituted benzaldehydes in order to determine the effect of electron withdrawing and electron releasing groups on the polarographic behavior of the carbonyl group. Coulometric data were collected on several of these substituted benzaldehydes and the products from the macroelectrolyses were isolated and identified. The course of the electrolytic reduction of aromatic aldehydes can be explained very well by careful analysis of the polarographic studies, coulometric data and identity of the reduction products of macroelectrolyses. The ease of double wave formation in basic solution was found to depend upon the nature of the substituted groups.

Various substituted benzophenones were investigated with the same object in mind. The polarography of these ketones was studied in buffered solutions over the pH range 2 to 13. Although no reduction products were isolated,  $n$  values were determined under various experimental conditions. In general the same type of behavior



was found with the aromatic ketones as had been found for the aromatic aldehydes. Again, the ease of double wave formation in basic solution was found to depend upon the nature of the substituted groups. Day (1), Shults and Millikin had postulated this behavior from their study of fluorenone, anthrone and benzophenone. In all cases aromatic ketones were found to reduce in a two-electron step more easily than the aromatic aldehydes.

Investigation of aliphatic ketones was possible only in very basic solution and with tetraalkylammonium salts as supporting electrolytes because very high potentials were necessary to effect reduction of the carbonyl group. In acidic and neutral media the reduction of the carbonyl group was masked by decomposition of supporting electrolyte or the evolution of hydrogen. Polarographic data indicated an electrode process of one electron for several of these ketones, whereas isolation of the products from a macroelectrolysis indicated a two-electron process. To account for the discrepancy between the polarographic and macroelectrolysis data it was postulated that the intermediate carbinolate free radical ion extracts a hydrogen atom from the solvent. Polarographic studies of the unusual molecule 2,2,4,4-tetraphenyl-3-oxetanone indicated that this very hindered ketone reduced by the addition of two electrons.

It was thought that the examination of some stereochemical aspects of electrolytic reduction might lead to a more detailed knowledge of the mechanism at the electrode surface. With this end in mind, a ketone,  $\alpha$ -methyldeoxybenzoin, with one asymmetric center was investigated. Upon reduction to the alcohol, a second asymmetric center was introduced into the molecule. Two alcohols, erythro and threo, can be written as possible reduction products for this ketone. Indeed, reduction of the ketone by the equilibrium controlled sodium in alcohol procedure gave a mixture of the erythro and threo alcohols. However, it was found that the erythro alcohol was formed exclusively on electrolytic reduction. Therefore it was assumed that the electrolytic reduction process must involve a rate-controlled step. Further, conclusions were drawn as to the actual conformation that the radical intermediate assumes on the electrode surface upon addition of the second electron.

A general mechanism for the reduction of carbonyl compounds is postulated, considering the work of previous investigators as well as the information collected in this study. Microfilm \$2.00; Xerox \$3.60. 63 pages.

#### DETERMINATION OF CHLORIDE BY PRECISION NULL-POINT POTENTIOMETRY

(L. C. Card No. Mic 59-602)

James Dudley Winefordner, Ph.D.  
University of Illinois, 1958

A new potentiometric technique is described for the rapid and accurate determination of chloride in the concentration range of  $10^{-6}$  to  $10^{-1}$  M. For many samples chloride results can be obtained in about a minute with relative errors less than 0.1% even at the 1 ppm level.

The method involves setting up a concentration cell consisting of an unknown chloride solution in a beaker and

a chloride reference solution in a small glass isolation compartment containing a micro opening which provides electrical contact but prevents any significant mixing of the two solutions. A pair of Ag-AgCl electrodes are used. One is placed in the reference and the other in the unknown solution. When the chloride concentration and the ionic strength in both the unknown beaker and the isolation compartment are the same, the potential across the electrode pair is zero or some small constant known potential.

The principle of the method is simply to change the chloride concentration of the unknown, while maintaining the ionic strength constant, until it is of identical chloride concentration to the reference as indicated by the null-point.

At the null-point the total quantity of chloride present in a volume ( $V_o + V_a$ ) is the sum of chloride present in the unknown,  $Q_u$ , and the quantity of chloride added,  $Q_A$ , assuming no chloride is contributed by the reagents or electrodes. Therefore the amount of chloride in the unknown is given by equation 1

$$Q_u = C_R(V_o + V_a) - Q_A \quad (\text{Eq. 1})$$

where  $Q_u$  and  $Q_A$  are defined above,  $C_R$  is the chloride concentration of the reference solution and  $V_o$  and  $V_a$  are volume of the sample taken for measurement and the volume of solution added to change the concentration of the unknown to the reference concentration, respectively. If the sample taken for measurement is more concentrated than the reference, then an electrolyte solution containing no added chloride is added, and if it is less concentrated than the reference, then an electrolyte solution containing twice the chloride concentration of the reference solution is most convenient to add. If the same reagents are used to prepare both sample and reference solutions and the characteristics of both electrodes are similar, it can be readily shown that the small chloride contributions from the reagents or electrodes will not enter into the calculation for the chloride content of the unknown. Consequently the final chloride result can often be obtained by the simple addition or subtraction of two numbers.

The precision null-point potentiometric method is applied directly to the determination of chloride in synthetic solutions, in blood serum and plasma samples and in ground and river water samples. The sample preparation procedures and the measurement of chloride by the proposed methods are described.

Because of the great sensitivity and accuracy of the precision null-point potentiometric method, a new simple and rapid technique for decomposing chlorinated organic compounds becomes feasible. The decomposition procedure consists of burning the organic sample, dissolved in acetone, by atomizing the solution into an oxygen-hydrogen flame and passing the hot vapors through a vycor tube attached to a special condenser. The condensate is collected directly in a volumetric flask containing the correct amount of supporting electrolyte. After dilution to volume, a portion of this solution is pipetted into a beaker and analyzed by the null-point potentiometric method. The chlorine found in low concentrations of chlorinated insecticides and oil fractions are also burned and determined by this method. The sample preparation, burnings and measurement procedures and results on pure chlorinated organic compounds, insecticide samples and oil fractions are presented.

Microfilm \$2.00; Xerox \$5.20. 101 pages.



## CHEMISTRY, ANALYTICAL

POLAROGRAPHIC DETERMINATION OF  
ALUMINUM, GALLIUM, AND INDIUM

(L. C. Card No. Mic 59-994)

Barbara Ann Cooney, Ph.D.  
Duke University, 1959

Supervisor: John H. Saylor

Aluminum, gallium, and indium are members of the IIIA periodic family and, therefore, have similar chemical properties. Mixtures of any two or of all three of the metals are difficult to determine quantitatively. The present investigation was undertaken in an effort to determine such mixtures polarographically.

The organic compound 5-sulfo-2,2',4'-trihydroxyazobenzene (Superchrome Garnet Y) has been found to react with aluminum, gallium, and indium forming chelates which are reducible at the dropping mercury electrode. Chelate-formation causes a negative shift in the half-wave potential of Superchrome Garnet Y producing a polarographic wave whose diffusion current is a linear function of the concentration of metal in solution.

At pH 5.53 each metal-Superchrome Garnet Y system investigated which contained excess chelating agent produced polarographic waves having half-wave potentials of approximately -0.34 v. and -0.53 v. and having diffusion currents which were linear functions of cation concentration. These waves were found to result from reduction of unchelated and chelated Superchrome Garnet Y, respectively, and were virtually independent of the chelating cation. Unlike aluminum, gallium and indium in the presence of Superchrome Garnet Y each produced a third wave. The third wave from the gallium-Superchrome Garnet Y system had a half-wave potential of approximately -1.05 v., and the third wave of the indium-Superchrome Garnet Y systems had a half-wave potential of -0.64 v. The diffusion currents of the third waves were also linear functions of the concentration of the specific chelating cation present.

As a result of the polarography of the Superchrome Garnet Y systems of aluminum, gallium, and indium at pH 5.53, polarographic methods have been developed for the analysis of aluminum, of gallium, of aluminum-gallium mixtures, of gallium-indium mixtures, and, over a limited range of concentrations, of aluminum-indium mixtures.

1. Aluminum can be determined in the concentration range of  $1 \times 10^{-6} \text{M}$  -  $1.6 \times 10^{-3} \text{M}$  within 3 percent.
2. Gallium can be determined in the concentration range of  $4 \times 10^{-6} \text{M}$  -  $2 \times 10^{-3} \text{M}$  within 5 percent.
3. Indium can be determined in the absence or in the presence of Superchrome Garnet Y by using the diffusion current of the third wave.
4. Aluminum can be determined in the presence of gallium by using the diffusion current of chelated Superchrome Garnet Y after subtracting the gallium contribution from the total diffusion current.
5. Gallium can be determined in the presence of aluminum if the concentration of aluminum is not more than five times greater than the concentration of gallium by using the diffusion current of the third wave.

6. Gallium can be separated from aluminum by extracting the chlorides with diethyl ether and determined polarographically.
7. Gallium and indium can be determined simultaneously by using the diffusion currents of the third waves of the respective systems.
8. Aluminum and indium can be determined simultaneously in the presence or in the absence of gallium if sufficient unchelated Superchrome Garnet Y is present to shift all of the chelate-forming reactions towards formation of the chelates. The indium-Superchrome Garnet Y chelate requires a 3-fold or more excess of unchelated Superchrome Garnet Y to shift the reaction towards formation of the chelate which limits the range of aluminum-indium concentrations that can be determined simultaneously.

The polarographic determinations developed during this work provided additional information concerning the nature of the reduction processes involved in the polarographic waves of the three metal-Superchrome Garnet Y systems, the legend to metal ratios of each metal-Superchrome Garnet Y system, and the relative stability of the three chelates. Microfilm \$2.05; Xerox \$7.20. 154 pages.

THE PARACHORS OF HYDROCARBONS,  
HEPTANES, NONANES, ALKYL CYCLO-  
PENTANES, ALKYL CYCLOHEXANES

(L. C. Card No. Mic 58-5177)

Anderson Eugene Robinson, Jr., Ph.D.  
Emory University, 1950

The surface tensions of eight isomeric heptanes, thirteen isomeric nonanes, eight alkylcyclopentanes, and seventeen alkylcyclohexanes have been measured, and the parachors have been calculated. The differential maximum bubble pressure method was employed in the measurement of surface tension. The original method and experimental technique of Sugden have been refined. Results warrant the claim of an accuracy of at least one tenth of one per cent.

Compounds have been made available by the National Bureau of Standards from materials prepared under the American Petroleum Institute research program. By reason of the extraordinary purity of the materials, above 99.73 mole per cent, it is believed that the data derived are more reliably accurate than similar data previously derived from materials of inferior quality. Surface tension and parachor data are presented at three temperatures for all compounds. In addition, liquid and vapor density and boiling point data required in the calculation of parachors are presented.

Aside from an interest in the measurement of surface tension and the determination of parachor for their value as fundamental constants, it has interested this laboratory to ascertain whether the parachor contributions of structural variations might be evaluated with an accuracy sufficient to permit the prediction of molecular parachors by the summation of contributions from structural units constituting molecules. For this application a number of



configurational units have been evaluated as they occur in members of the alkane series.

The data presented attest the validity of the theory of the additivity of structural unit parachor contributions. The average deviation between experimentally observed and calculated parachor values for twenty alkanes is 0.21 per cent. Structural unit contributions evaluated from non-cyclic alkanes have been applied to the prediction of the parachors of fourteen alkylcycloalkanes. The average deviation is 0.31 per cent.

Microfilm \$2.00; Xerox \$3.00. 54 pages.

## CHEMISTRY, BIOLOGICAL

### THE BIOSYNTHESIS OF ERGOTHIONEINE

(L. C. Card No. Mic 59-862)

Robert William Ban, Ph.D.  
University of Southern California, 1958

Chairman: Professor Ellery Stowell

A biosynthetic pathway leading to the production of ergothioneine, the betaine of thiolhistidine, has been elucidated in this study. This compound was discovered in ergot and later was found in the red blood cells and certain tissues of mammals. Despite its discovery almost fifty years ago, it remains in many respects a physiological and biochemical enigma.

At the time this study was begun it was not known whether ergothioneine was synthesized by animals or accumulated from the diet. Therefore, the ergot fungus, *Claviceps purpurea*, was selected for studying its biosynthesis. The fungus was grown under controlled conditions in submerged culture on a medium of defined composition. The production of ergothioneine in high concentration amounting to about 0.1 per cent of the dry weight of the fungus was shown by subjecting the fungal extracts to both paper and alumina-column chromatography. Ergothioneine was found in the fungal contents and not in the external culture medium.

Following this demonstration, the intermediates of the biosynthetic process were investigated. Because of the structural relationship of ergothioneine to histidine, the latter compound was tested as an intermediate in the pathway of ergothioneine biosynthesis. Methionine was also studied to determine whether it could furnish the methyl groups of ergothioneine. The organism was grown on a medium supplemented with histidine- $\alpha$ -C<sup>14</sup>. The radioactivity of the isolated ergothioneine showed close similarity with the administered histidine- $\alpha$ -C<sup>14</sup> when the specific activities were compared. This was indicative of a close precursor relationship between histidine and ergothioneine.

The ergothioneine isolated from the fungus grown on methionine methyl-C<sup>14</sup> was degraded, and essentially all of the radioactivity was found to be confined to the trimethylamino portion of the molecule, indicating that methionine can furnish methyl groups for the biosynthesis of ergothioneine.

Turning to the origin of the sulfur of ergothioneine, the suspected intermediate, S-alanyl ergothioneine, was synthesized. *Claviceps* was grown on S35-sulfate and the fungal extracts subjected to two-dimensional paper chromatography. S-alanyl ergothioneine was added to the extract prior to chromatography of the extract. Radioautograms were prepared. A region of radioactivity corresponding to the R<sub>f</sub> of S-alanyl ergothioneine was found on the radioautograms. This spot was cut out from the paper chromatogram and cochromatographed with S-alanyl ergothioneine. A new radioautogram was prepared which showed that both the position on the paper and the radioactivity matched identically, providing proof that S-alanyl ergothioneine occurred naturally in the fungus. The results of this study have indicated that ergothioneine arises from histidine, methionine, and cysteine, probably through the intermediate, S-alanyl ergothioneine.

Microfilm \$2.00; Xerox \$4.40. 85 pages.

### PURIFICATION OF LEUCINE AMINOPEPTIDASE AND ALKALINE PHOSPHATASE FROM PIG KIDNEY

(L. C. Card No. Mic 58-5113)

Fred E. Bell, Ph.D.  
Emory University, 1958

Cysteinylglycinase from hog kidney has previously been found to be resistant to prolonged proteolytic digestion and to the usual procedures for denaturing protein.<sup>1</sup> The possibility was investigated that cysteinylglycinase is but a single member of a group of related kidney peptidases which, by virtue of their stability characteristics, might be concurrently purified by a modification of the method previously employed in the purification of cysteinylglycinase, followed by separation of the enzymes by chromatographic or chemical techniques.

In the preparation of an enzyme concentrate, pig kidney homogenates were digested with proteolytic enzymes for 2-4 weeks, followed successively by fractionation with alcohol, emulsification of the active fraction with a mixture of octanol and chloroform, treatment with Norit-A and, finally, dialysis. Each step was conducted at room temperature at a pH of approximately 8. Particular emphasis was placed upon standardization of conditions favoring the maximum purification and recovery of leucine aminopeptidase and alkaline phosphatase as well as cysteinylglycinase. Because of a stabilizing effect upon leucine aminopeptidase, 0.005 M magnesium was included in the enzyme solutions during purification.

A variety of peptidase activities as well as one or more alkaline phosphatases were found to be resistant to this procedure. The enzymes in the concentrate were then separated into a number of fractions by procedures involving divalent ions and fractionation with either ethanol or changes in pH; separation with ion exchange resins and neutral adsorbents was unsuccessful, probably because of insufficient purification. Alkaline phosphatase was separated quantitatively from the peptidases by a procedure involving the barium ion and fractionation with ethanol. Differences in the distribution of enzymatic activities among the fractions and gross differences in the metal activation of each of these activities were interpreted to



indicate the presence of a large number of highly specific enzymes. Activity toward amino acid esters was observed and evidence for a leucylglycine dipeptidase, distinct from leucine aminopeptidase, was found. The magnitude of purification for all the enzymes was quite high; leucine aminopeptidase having a  $C_1 = 50$  and alkaline phosphatase having a specific activity of 20,000 were routinely obtained. An even greater degree of purification is believed to be essential before column chromatography can be used to advantage in the separation of the enzymes.

Microfilm \$2.00; Xerox \$6.80. 141 pages.

1. Binkley, F., *J. Cellular Comp. Physiol.*, **40**, Suppl. 2, 145 (1952).

#### CERTAIN ASPECTS OF THE BIOSYNTHESIS OF CHLORAMPHENICOL

(L. C. Card No. Mic 59-483)

Richard William Burg, Ph.D.  
University of Illinois, 1958

The biosynthesis of chloramphenicol by both growing cultures and washed mycelia of *Streptomyces venezuelae*, R1 and *Streptomyces* sp. 3022A was studied by means of carbon-14 labeled compounds. The washed mycelia were found to be far superior in these studies.

Experiments with glycerol-1,3- $C^{14}$  and sodium lactate- $U-C^{14}$  indicate that the side chain of p-nitrophenylserinol arises from an intact three-carbon intermediate. Of these two substrates which comprise the carbon source in the medium used for chloramphenicol synthesis, glycerol is used preferentially for the carbon skeleton of chloramphenicol. These same experiments indicated that the dichloroacetyl moiety arose from a Krebs cycle intermediate.

The marked stimulation of chloramphenicol synthesis by phenylalanine and the finding that uniformly-labeled phenylalanine contributed almost exclusively to the dichloroacetyl moiety of chloramphenicol led to an investigation with specifically labeled phenylalanine. Phenylalanine-2- $C^{14}$  caused only slight labeling of chloramphenicol (probably by carbon dioxide fixation). However, phenylalanine-3- $C^{14}$  was found to contribute its label to the dichloromethyl carbon with fairly low dilution. It is possible to explain this labeling pattern by metabolism of phenylalanine via homogentisic acid although a new pathway of phenylalanine metabolism seems more likely.

Stimulation of chloramphenicol biosynthesis by norleucine led to a thorough study of the role played by propionate, a product of norleucine catabolism, in chloramphenicol biosynthesis. The labeling patterns in chloramphenicol indicated that propionate was carboxylated to succinate and metabolized by way of the Krebs cycle. A study of propionate metabolism in cell-free extracts provided evidence that propionate was indeed carboxylated to give succinate.

Liquid scintillation counting was used for the assay of many of the compounds isolated, and barium carbonate was counted by gel-suspension counting. This method was found to be simple, rapid, and extremely sensitive and accurate. It was superior in nearly every way to counting by vibrating-reed electrometer for the assay of low activity samples.

Experiments with cell-free extracts and sodium chloride-36 provided evidence for the synthesis of organic chlorine-containing compounds. Two such compounds were isolated by silicic acid column chromatography. Neither the identities nor the roles of these compounds in chloramphenicol biosynthesis have been established.

A simple method for the removal of inorganic chloride for the assay of organic chlorine compounds by chlorine-36 is described.

Microfilm \$2.65; Xerox \$9.20. 202 pages.

#### CHROMOGENIC PEPTIDES IN THE FOLIN (LOWRY) COLORIMETRIC PROTEIN DETERMINATION

(L. C. Card No. Mic 59-254)

Shao-Chia Chou, Ph.D.  
Stanford University, 1958

In the Lowry modification of the Folin-Ciocalteu phenol determination proteins give an intense blue color, which is the reduced form of the phospho-tungsto-molybdate in the phenol reagent. The purpose of the investigation reported here was to ascertain what constituents of proteins were responsible for the color yield.

It was shown that of the natural amino acids only tyrosine and tryptophan, to a lesser extent cysteine and cystine, to a still lesser extent histidine yielded color in this reaction. The color yield of proteins was shown to be several times greater than could be accounted for by their constituent amino acids. This additional color is not obtained after complete hydrolysis, nor in the absence of Lowry's alkaline copper pretreatment. It followed that certain sequences of amino acids are probably responsible for the greater part of the protein color.

Mixtures of amino acids had no significant influence on the color yield. Certain dipeptides, however, were shown to give a great deal more color than their components individually, and this additional color was copper-dependent. The dipeptide color requires the presence of an intact  $\alpha$ -amino group but probably not of an intact  $\alpha$ -carboxyl. There is a gradual increase of color with increasing side-chain length of simple amino acids without functional side-chains, and a considerable increase of color when side-chain amino groups are present terminally or in a heterocyclic ring. In a simple tripeptide of glycine the color yield was very high, presumably because the additional peptide-nitrogen could participate in the reaction.

On the basis of the studies with amino acids and peptides it was proposed that whereas a few amino acids can reduce the phenol reagent directly, the copper-dependent additional color arises from an intermediate copper chelate. The structural features favorable to such chelate formation were discussed. As the phenol reagent itself is extraordinarily unstable (half-life 8 seconds) at the alkaline pH of the reaction, it is surmised that the principal role of the copper chelate is to facilitate removal of electrons (or hydrogen) from substrate to phenol reagent before the latter is completely destroyed. That the substrate is not completely reacted even when high color yields are obtained was shown for histidylhistidine, which could give more color on addition of fresh phenol reagent.



It had been hoped that the color reaction might prove specific for a very few amino acid sequences in protein, but this proved not to be so. Bovine albumin and insulin were degraded to smaller polypeptide fragments whose color yields were then studied. This phase of the investigation showed, in general, that peptides containing tyrosine (provided they were small enough for tyrosine to contribute a significant fraction of the total color) lost relatively little color on complete hydrolysis, i.e. most of the color was due to tyrosine. Other peptides lost variable amounts of color on complete hydrolysis, depending on their content of highly chromogenic sequences. Peptide bonds in themselves must contribute but little of the total color, in contrast to what is generally believed about the biuret reaction.

Partial light was thrown on the reaction mechanism through the isolation of a product after reacting histidyl-histidine with alkaline copper and phenol reagent. Indirect evidence indicated that hydrogen had probably been removed from the free amino group and from one imidazole ring, with formation of a new heterocyclic ring. Molecular models permitted a plausible reaction sequence to be proposed, in which chelation with copper plays an essential role.

Microfilm \$2.00; Xerox \$4.80. 91 pages.

#### PURIFICATION AND CHARACTERIZATION OF TRANSPEPTIDASES OF SWINE KIDNEY

(L. C. Card No. Mic 58-5121)

Gerald Martin Christensen, Ph.D.  
Emory University, 1958

In view of the possibility that the formation of gamma-glutamyl peptides is an important intermediate step in the synthesis of protein and the absorption and transfer of amino acids, a great deal of interest has become attached to the enzymes responsible for the formation of these compounds. Although several studies of this system have been carried out in recent years, they have been handicapped by the difficulty encountered in obtaining the active material in soluble and somewhat purified form. Various means of protein extraction and solubilization were studied in the hope of obtaining enzymatically active material in a state of purity which would permit a more definitive study of its properties. The method of preparation finally devised is rapid, simple, and capable of yielding a preparation of reasonable purity and stability. This method involves primary extraction of swine kidney homogenates with the detergent sodium lauryl sulfate in combination with  $MgCl_2$  followed by fractionation with ethanol, adsorption of impurities on kaolin, and fractionation with ammonium sulfate. The resulting enzyme preparation was 40-50 fold purified and was deemed sufficiently free of extraneous material to permit a study of its properties. It was found to have a pH optimum of pH 8.0, and require  $Mg^{++}$  ion and the presence of a suitable amino acid or peptide acceptor for maximal activity. The simple hydrolysis of glutathione was not observed and the transpeptidase also required the presence of the enzyme responsible for the cleavage of cysteinylglycine for maximal activity. The previously reported inhibition of gamma-glutamyl transfer by low concentrations of penicillin G was confirmed and

this inhibition was shown to be reversible by an increase in substrate or acceptor concentration. Certain preparations of the transpeptidase were obtained which displayed more limited acceptor requirements than were observed in studies carried out with crude homogenates.

A study was also made of the gamma-glutamyl transpeptidase in the kidneys of mice, hamsters, and intact and hypophysectomized rats. While the properties of the material obtained from the tissues of these animals were very similar to that obtained from swine kidney, it was found that the level of activity in the kidney of hypophysectomized rats was 2.0 to 3.0 times higher than in the kidneys of intact animals of the same sex, age, and strain. Treatment of hypophysectomized rats with various growth hormone preparations did not bring about a return to normal of the transpeptidase level of kidney.

A greater degree of purification must be accomplished before definitive statements regarding mechanism of the reaction or its significance in cellular economy may be made.

Microfilm \$2.00; Xerox \$4.20. 79 pages.

#### THE CONSTITUTION OF STARCH DEXTRINS

(L. C. Card No. Mic 59-1311)

Glenn M. Christensen, Ph.D.  
University of Minnesota, 1957

The constitution of dextrins prepared from whole starch, amylopectin and amylose was investigated to ascertain the structural transformations which take place during dextrinization, by heating at  $140^\circ C$ . in the presence of catalytic amounts of hydrochloric acid. A homogeneous fraction of each dextrin was obtained by fractional precipitation of both the dextrin and its acetate.

Each of the dextrins was methylated and then hydrolyzed to give a mixture of methylated sugars. The hydrolyzate was resolved by column chromatography and each methyl sugar was identified by preparing a crystalline derivative.

A summary of the methylation studies of the three dextrins is shown in Table A.

Table A  
Methyl Sugars Produced by Hydrolysis of the  
Methylated Dextrins

Component Methyl Derivative	Amount (Mol. percent) of Component Sugars		
	Whole Starch (Wheat) Dextrin	Amylopectin (Waxy Corn Starch) Dextrin	Amylose (Corn) Dextrin
1. 2,3,4,6-Tetra-O-	12.2	16.4	12.7
2. 2,3,6-Tri-O-	74.8	65.5	72.9
3. 2,4,6-Tri-O-	-	2.1	5.2
4. 2,3-Di-O-	3.9	8.4	5.2
5. 2,6-Di-O-	7.9	5.5	3.6
6. 2-O-	0.9	1.2	0.2
7. 3-O-	0.3	0.6	0.2
8. 6-O-	-	0.3	-



Inspection of Table A shows that each of the three methylated dextrans provided from six to eight different hydrolysis products which indicated that the dextrans possess a more complex structure than the parent substance, as hydrolysis of methylated whole starch and amylopectin yields only three products while methylated amylose, upon hydrolysis, yields only two products. The isolation of a relatively high yield of 2,3,4,6-tetra-O-methyl-D-glucose indicated that the dextrans possess a high degree of branching. A considerable amount of this branching is formed at position three during dextrinization, as revealed by the isolation of 2,4,6-tri-O-methyl-D-glucose and 2,6-di-O-methyl-D-glucose, neither of which is isolated from the hydrolyzate of the methylated parent substance. The isolation of 2,3 and 2,6-di-O-methyl-D-glucose, especially from the hydrolyzate of the methylated dextrin prepared from corn amylose, indicated that branching linkages of the dextrin molecule also exist at position six.

The results of end group analysis by methylation studies showed that for the three dextrans investigated, the average number of anhydroglucose residues per repeating unit varied from six to eight.

End group analysis of the three dextrans by periodate oxidation furnished results which agreed with those obtained from methylation studies. Periodate oxidation studies also revealed that approximately 10% of the constituent anhydroglucose residues of each of the three dextrans were immune to the action of sodium periodate; a large amount of this resistance to periodate oxidation is probably due to the presence of 1,3 linkages as revealed by the methylation studies. The dextrans contain approximately twenty times more glucose residues that are resistant to periodate oxidation than the parent polysaccharides.

Co-dextrinization was found to occur when a polysaccharide (amylopectin, guar gum galactomannan, or yeast mannan) mixed with a mono-saccharide (D-xylose, D-galactose, or D-glucose) or a disaccharide (D-lactose or D-mannose) was heated at 140° C. in the presence of an acid catalyst. The products, termed "co-dextrans," of each co-dextrinization reaction were purified by fractional precipitation and analyzed for component sugars after hydrolysis. The amount of "foreign" sugar that was incorporated into the polysaccharide during dextrinization varied from two to eight percent.

The co-dextrinization reaction provides a new approach to the formation of an entirely new group of dextrin-like products which may prove to be of commercial value.

Microfilm \$2.00; Xerox \$5.80. 117 pages.

#### PART I. AMINO ACID DECARBOXYLASES OF SALIVARY SEDIMENT.

#### PART II. THE INHIBITION OF ANAEROBIC GLYCOLYSIS BY SODIUM N-PALMITOYL SARCOSINATE.

(L. C. Card No. Mic 59-208)

Nathan Gochman, Ph.D.  
Northwestern University, 1958

Supervisor: L. S. Fosdick

#### PART I

The amount and distribution of microbial amino acid decarboxylases in the sediment of incubated saliva was determined. An attempt was made to correlate the decarboxylating activity of the salivary sediment with the periodontal condition of the donor.

The saliva sediment was prepared as follows: 15 ml of saliva was obtained by paraffin stimulation and made 3% in casein hydrolysate in a screw cap vial. This was incubated for 4 hours at 37°C in a rotating water bath and then centrifuged. The sediment was washed twice with distilled water and diluted to 12 ml with phosphate buffer. Two ml aliquots of this suspension served as the enzyme source. Enzyme activity was determined by the quantity of CO<sub>2</sub> evolved at 37°C, under an N<sub>2</sub> atmosphere in a Warburg apparatus.

Arginine, ornithine, glutamic acid, histidine and lysine were decarboxylated by the saliva sediment preparation. These amino acids were acted on optimally at a pH of 6.5. Unincubated saliva did not exhibit a measurable activity, and incubated saliva without the prior addition of casein hydrolysate yielded a suspension with only one-fourth the activity.

A study was conducted to compare the amino acid decarboxylase activity of the saliva from normal individuals and those suffering from periodontal disease. Patients at the Northwestern University Dental Clinic were used as subjects for the investigation. The saliva from a group of 50 periodontal patients showed a statistically significant higher mean decarboxylating activity for each of the five amino acids tested, than that of a group of 50 normal patients. There was, however, considerable overlapping in the activity values for the two groups.

It was found that the relative activities toward each of the amino acids was similar in all samples, from normal and periodontal saliva. Arginine, ornithine, glutamic, histidine and lysine accounted for about 28, 51, 8, 7 and 5 per cent, respectively, of the total CO<sub>2</sub> evolved.

#### PART II

It had been demonstrated that sodium N-lauroyl sarcosinate is an effective inhibitor of the hexokinase reaction and a dentifrice employing this compound brought about a significant reduction in caries incidence. The homologous compound, sodium N-palmitoyl sarcosinate, was reported to greatly reduce the solubility of dental enamel in acid medium. This study was made to determine if sodium N-palmitoyl sarcosinate (SPS) would inhibit anaerobic glycolysis.

Using intact yeast cells, SPS was shown to be an effective inhibitor of the production of acidic glycolytic intermediates and of glucose degradation. However, when



acetone-dried yeast preparations were used SPS had no effect on glycolysis. SPS would not inhibit the hexokinase reaction, even in relatively high concentrations.

It was concluded that SPS would only exert an inhibitory effect on glycolysis if the intact cell membrane was present. Microfilm \$2.00; Xerox \$4.00. 71 pages.

#### A STUDY OF FACTORS AFFECTING NUTRIENT UTILIZATION WITH SPECIAL REFERENCE TO CALCIUM

(L. C. Card No. Mic 59-974)

Frank Konishi, Ph.D.  
Cornell University, 1958

Chemical balance studies were conducted with twelve adult male Beagles to determine the effects of various factors upon the utilization of calcium and other nutrients. The factors studied were exercise, dietary source of carbohydrate, limitation of water intake, and irradiation of the food supply.

When dogs were exercised daily on a treadmill for 30 minutes at 3.7 miles per hour and at a gradient of 15 degrees, the only significant finding was an increase in fecal calcium. The utilization of the other nutrients was not affected by this amount of exercise.

A greater excretion of fecal calcium occurred when 50 percent of the diet was potato flour than when it was either sucrose or corn starch. The retentions, however, were not influenced by the source of carbohydrate.

When the water intake was limited to one-third of that normally drunk by the dogs, the retentions of calcium, phosphorus, and nitrogen were increased. The utilization of dry matter and carbohydrate was also increased.

Irradiating 25 percent of the diet at  $6 \times 10^6$  rads did not affect the utilization of calcium. However, an increased phosphorus retention and decreased utilization of ether extract were observed.

Microfilm \$2.00; Xerox \$5.60. 112 pages.

#### STUDIES ON THE BIOCHEMISTRY OF ELASTIC TISSUE AND THE EFFECTS OF AGING AND EXOGENOUS STEROIDS ON THE METABOLISM OF THE RAT AORTA

(L. C. Card No. Mic 58-5156)

Frank Sebastian LaBella, Ph.D.  
Emory University, 1957

The present investigation includes studies designed to characterize the nature of the unknown Schiff-reactive substance(s) reported to be present in elastic tissue. Secondly, studies on the normal components of the aging aorta have been lacking, and the effects of exogenous hormones have been limited to determinations of aortic lipids. In the present investigation changes in components besides lipids have been studied chemically and isotopically in the rat aorta as influenced by aging and by administered steroids. Hydrocortisone and diethylstilbesterol were em-

ployed since corticoids and estrogens are reported to act oppositely on the connective tissue elements.

Three Schiff-reactive compounds have been detected in elastic tissue prepared from beef ligamentum nuchae. From powdered ligamentum treated with hot alkali, a glycolipid has been isolated which has been identified as a cerebroside on the basis of chemical and histochemical studies. Ligamentum powder which has been treated with alkali and also exhaustively defatted still contains two Schiff-positive substances, unsaturated fatty acid(s) and an acetal linkage. Upon enzymatic hydrolysis of the defatted protein, some of the bound fatty acid is released, but all of the acetal is believed to be bound to the soluble protein. These findings have explained the controversial results reported in the literature on the Schiff reaction in elastic tissue. Phosphorus has been demonstrated in rigorously extracted elastin and is believed to exist as phosphoprotein. The protein phosphorus was shown, using radioisotopic techniques, to be more metabolically active than phospholipid or alkali-labile phosphorus compounds.

Up to ten months of age, the oldest group of animals studied, the rat aorta increases in size. The elastin content of the aorta decreases sharply from one to three months of age, after which the curve tends to level off. The amount of both elastin and the alkali-soluble fraction of the aorta increases with age, the latter at a much greater rate. The significance of the changes in the relative proportion of gel to fiber in connective tissue with age is discussed. The inorganic phosphorus content of aortic elastin increases progressively with age, while the inorganic phosphorus of the serum decreases. Aortic alkali-soluble phosphorus decreases with age, and aortic lipid phosphorus is apparently unchanged. When radiophosphate is administered to rats, the specific activities of all fractions in the aorta are higher in older than in young animals. When the blood inorganic P-32 is studied, its specific activity is higher the older the animal. This explains in large part the apparent increase in phosphorus turnover in the aorta with progressive age.

Hydrocortisone administered to immature female rats results in an elevated P-32 labelling of the alkali-soluble tissue of the aorta. This same steroid administered to adult males produces an elevated labelling in serum and aortic inorganic phosphorus and suggests an elevation in aortic alkali-soluble phosphorus. Hydrocortisone administered to adult females results in an inhibition of labelling of all blood and aortic fractions. The significance of these findings in relation to the sex hormones is discussed. Hydrocortisone in every instance produces a several-fold elevation in aortic fat. Hydrocortisone and diethylstilbesterol administered to adult male rats apparently act quite similarly in their effects on phosphorus metabolism. The specific activities of aortic and serum inorganic phosphorus are elevated by both steroids, and elevated specific activities of alkali-soluble phosphorus is suggested. Both steroids lower the specific activity of phospholipid phosphorus. Serum inorganic phosphorus seems to be lowered by hydrocortisone and diethylstilbesterol. Estrogen does not produce lipid deposition in the aorta characteristic of hydrocortisone. Both hydrocortisone and diethylstilbesterol appear to affect the physico-chemical properties of elastin, although in opposite ways.

Microfilm \$2.05; Xerox \$7.20. 155 pages.



# INVESTIGATION OF THE RELATION OF INSULIN TO LIPID METABOLISM, WITH SPECIAL REFERENCE TO PHOSPHOLIPID

(L. C. Card No. Mic 58-5160)

Eva Cunningham McGhee, Ph.D.  
Emory University, 1949

The purpose of the investigation was to determine the relation of insulin to certain phases of lipid metabolism with special reference to phospholipid. Four groups of rabbits were used for the experiments and a group of 12 normal fasting rabbits were used as a source of tissue to determine the normal mean values of lipid phosphorus for brain and liver.

The first group of 12 animals were given massive doses of insulin under fasting conditions and were killed by insulin shock. In the second group, 6 animals were made diabetic by the injection of alloxan. The 6 animals of the third group were given lecithin intravenously, and the 6 animals of the fourth group were given massive insulin doses, followed by an intravenous injection of lecithin.

Statistical appraisal of the blood and tissue analyses showed the following results. Massive doses of insulin produce a significant decrease in the blood total fatty acids and lipid phosphorus, as well as in blood glucose. The absence of insulin in alloxan-diabetic animals results in a significant increase in blood total fatty acids and lipid phosphorus. Administration of lecithin, to normal and to insulinized rabbits, causes no significant change in the total fatty acids and lipid phosphorus of the blood after about 5 hours. A significant increase in the blood glucose is associated with the administration of lecithin to normal animals, but lecithin administration does not alter the course of insulin action on blood sugar in the insulinized rabbits. Blood cholesterol shows no significant change under the conditions studied.

No significant change is shown by the lipid phosphorus of the liver in any of the groups investigated. Liver glycogen and bile lipid phosphorus vary widely in the cases in which these determinations were made. Neither the absence of insulin in alloxan-diabetic animals nor the administration of lecithin to normal animals produces a change in the brain lipid phosphorus content. Massive doses of insulin effect an absolute and significant decrease in the brain lipid phosphorus; this decrease is not alleviated by the administration of lecithin in the amount given.

Experiments for further clarification of the role of insulin in phospholipid metabolism are suggested.

Microfilm \$2.00; Xerox \$5.60. 114 pages.

## BIOCHEMICAL STUDIES ON myo-INOSITOL

(L. C. Card No. Mic 59-548)

Ezio Anthony Moscatelli, Ph.D.  
University of Illinois, 1958

Investigations were undertaken with the aim of elucidating the metabolism of myo-inositol in the whole rat and determining the nature of inositol-containing lipopeptides in brain.

myo-Inositol- $C^{14}$  was prepared photosynthetically from

$C^{14}O_2$  and young corn plants, and was used to quantitatively investigate three pathways of myo-inositol metabolism in the whole rat.

A vigorous oxidative dissimilation to  $CO_2$  was found to account for 10 to 25 per cent of the administered radioactive dose. Labeling of liver glycogen was used to demonstrate a much smaller conversion to glucose, and a comparably small amount was shown to be incorporated into organ lipides.

These metabolic studies have been previously reported (1) and are presently in press (2).

An unsuccessful attempt was made to demonstrate phosphorylation of myo-inositol by rat liver preparations, nor was it possible to demonstrate the presence of an inositol nucleotide in rat liver.

A partially purified, chloroform-methanol soluble lipopeptide has been isolated from a trypsin-resistant residue of beef brain. This material, designated as Fraction P, was obtained by water precipitation from a total crude lipopeptide extract in chloroform-methanol.

Fraction P has been found by acid degradation studies to contain myo-inositol, a hexosamine, lipide, amino acids, and phosphorus. The myo-inositol is apparently present as the diphosphate, and the hexosamine is likely to be either galactosamine or glucosamine.

In addition, a partial degradation product has been obtained by the action of acidified chloroform-methanol on fraction P. This product, designated as fraction F, is insoluble in solvents or in water.

Fraction F has been found by acid degradation studies to contain the same components as fraction P with the exception of lipide.

## REFERENCES

1. Moscatelli, E. A., and Larner, J., Federation Proc., **16**, 223 (1957).
2. Moscatelli, E. A., and Larner, J., Archives Biochem. Biophys. (In Press).

Microfilm \$2.00; Xerox \$5.20. 102 pages.

## THE EFFECT OF DIISOPROPYL-FLUOROPHOSPHATE ADMINISTRATION ON THE PHOSPHORUS METABOLISM OF MOUSE BRAIN

(L. C. Card No. Mic 59-1284)

Walter Leland Nelson, Ph.D.  
University of Minnesota, 1958

The intraperitoneal injection of diisopropylfluorophosphate (DFP) to mice in a dosage of 2.5 mg./kg. was found to result in a reduction of  $P^{32}$  transfer from inorganic phosphate to total phospholipids and pentose nucleic acid of the brain.

The energy-supplying processes in the brain were apparently not affected by this dosage of DFP, since brain lactic acid and creatine phosphate levels were not significantly altered at the time of sacrifice.

This effect of DFP on  $P^{32}$  incorporation was also evident in the lecithin fraction of brain phospholipids.

A study of the kinetics of  $P^{32}$  transfer from phosphorylcholine to lecithin indicated that DFP administration had an effect at the final stages of lecithin formation.



Various interpretations of these results are considered. It is proposed that an interference with phosphorus metabolism of the brain may be responsible for some of the pharmacological effects of DFP.

Microfilm \$2.00; Xerox \$4.60. 86 pages.

#### A STUDY OF FACTORS AFFECTING BLOOD GLUCOSE TURNOVER

(L. C. Card No. Mic 59-645)

George Andrew Reichard, Jr., Ph.D.  
Temple University, 1958

An isotope tracer procedure was applied to determine how much of the hypoglycemic action of insulin is due to inhibition of entry and how much to stimulation of removal of blood glucose. Unanesthetized, fasting dogs as well as non-diabetic and diabetic humans were the subjects of the investigation. They were given a trace dose of glucose- $C^{14}$  and blood samples were then removed at frequent intervals before and after intravenous insulin administration for assay of blood glucose content and specific activity. Before insulin injection, the glucose level remained essentially constant and its specific activity fell logarithmically, indicating a constant turnover of approximately 1.0 mg. per 100 ml. per min. in the normal dog and non-diabetic human; the diabetic human had a higher turnover of about 1.6 mg. per 100 ml. per min. Immediately after insulin, the specific activity reached a plateau and remained constant throughout the initial phase of hypoglycemia. As the blood sugar leveled off and slowly rose, the specific activity resumed its downward trend. Using certain equations, these results clearly show that insulin exerts its hypoglycemic action both by inhibiting the entry of new glucose molecules into the blood and by accelerating their removal. From one-fourth to one-half of the total drop in blood sugar was estimated to be due to inhibition of entry and the remainder to increased removal. It is suggested that the immediate inhibition of blood glucose entry and acceleration of removal may arise from a dual action of insulin, bound to the cell surface, in favoring the inward and preventing the outward flow of the sugar.

The study of blood glucose entry and removal rates during hyperglycemia in normal dogs has shown, not only that hepatic glucose output is suppressed during hyperglycemia, but that simultaneous administration of insulin with either glucose or glucagon intensified the rate of glucose disappearance following either type of hyperglycemia but otherwise did not affect the pattern of response to hyperglycemia. These results are in accord with the hypothesis that suppression of blood glucose entry during hyperglycemia is a reflection of an immediate effect of insulin on hepatic glucose output.

Although hepatic glucose output is suppressed during hyperglycemia in normal animals, the studies in humans show that this is not true in the diabetic patients at their hyperglycemic levels, since they consistently exhibited turnover rates at least as high as their normal counterparts. This is interpreted to indicate that the diabetic hyperglycemia is, in part at least, directly due to inability of the animal lacking insulin to control hepatic glucose output.

The importance of this action of insulin in controlling glucose output by the liver has been strikingly demonstrated in studies using subcutaneous insulin administration. Under such conditions, while insulin is being liberated in a more physiological manner, it has been shown that the hormone has little if any effect on the peripheral utilization of glucose, but causes a sustained suppression of hepatic glucose output. This fact strongly suggests that its effect on the liver may be more important in the physiological regulation of the blood sugar level than has previously been suspected.

Microfilm \$2.00; Xerox \$5.20. 101 pages.

#### AMINO ACID SEQUENCES IN GELATIN

(L. C. Card No. Mic 59-883)

Frederick Muhl Robbins, Ph.D.  
Lehigh University, 1958

Gelatin was reacted with phenyl isothiocyanate, to form phenyl thiocarbamyl (PTC) gelatin. The reaction was followed by titration with sodium hydroxide. From the titration data and a sulfur determination, on the PTC gelatin, it was found that essentially all the free amino groups of the protein had reacted.

The PTC gelatin was hydrolyzed with 1 N HCl and the phenyl thiocydantoin (PTH) derivatives, which were formed, were extracted with ethyl acetate. The thiocydantoin derivatives were separated by paper chromatography, and the derivatives of alanine, aspartic and glutamic acid, glycine, leucines, phenylalanine, proline, tyrosine, and valine were found. This showed that these amino acids occurred as N-terminal residues in the gelatin sample.

PTC gelatin was digested by trypsin, and the resulting hydrolyzate separated by continuous paper electrophoresis. It was found that PTC gelatin was degraded about 25 percent less than gelatin, by trypsin, indicating that conversion of the  $\epsilon$  amino groups of lysine to PTC groups may possibly be responsible for the lesser amount of degradation of PTC gelatin. It was also found that the N-terminal PTC groups were unstable under the conditions used for electrophoresis. Several of the peptide fractions were further separated by paper chromatography. From the results of this separation and the electrophoretic separation, it was found that the protein hydrolyzate was very complex, and contained peptides of high molecular weights. One of the fractions, obtained from the electrophoretic separation, was found to separate into five fractions when chromatographed on paper. The fractions were eluted from the paper and one of them investigated further. A quantitative amino acid analysis showed that this peptide had a minimum molecular weight of about 10,000. By use of the Edman degradation, it was found that serine was the N-terminal residue, and the sequence from the amino end was probably Ser-Gly-. All amino acids occurred to about the same extent as in gelatin and collagen with the exception of glycine, which was present at about 43 mole percent, and proline, hydroxyproline and aspartic acid which occurred to about 1/2 their values in gelatin and collagen.

Microfilm \$2.00; Xerox \$7.00. 150 pages.



# AN INORGANIC PYROPHOSPHATASE OF SWINE BRAIN

(L. C. Card No. Mic 58-5180)

Ulysses Samuel Seal III, Ph.D.  
Emory University, 1957

The inorganic pyrophosphatases have been found in every organism and tissue investigated. Interest in these enzymes has increased since the discovery of biochemical reactions leading to the formation of inorganic pyrophosphate. These enzymes are also of interest for the study of enzymatic mechanisms. The most pressing current problem for further study of the inorganic pyrophosphatases is their purification and characterization.

Two procedures for the purification of the alkaline pyrophosphatase of swine brain are described. The enzyme was obtained by extraction with 0.1 M magnesium chloride. The extract was then made 0.2 M with respect to magnesium chloride and then 500 mg./l. of sodium lauryl sulfate was added. The solution was heated one hour at 37°, cooled, centrifuged, and the precipitate discarded. The two procedures diverge at this point. The first method, giving the greatest purification, involved shaking with a chloroform-octanol mixture, collection of the aqueous layer, and clearing with the aid of Hy-Flo Supercel and filtration. The enzyme was adsorbed on alumina gel and eluted with pH 6.5 phosphate buffer. This material was then fractionated with ammonium sulfate and by isoelectric precipitation. A preparation purified 165-fold was obtained. In the second procedure the solution from the sodium lauryl sulfate step was fractionated with ammonium sulfate and by precipitation at pH 4.7. The material thus obtained represented a 100-fold purification and was also free of adenosinetriphosphatase activity.

The pyrophosphatases of white potato were also purified for comparative purposes. One kilogram of potatoes was extracted with water and the pulp-free extract fractionated with ammonium sulfate and by isoelectric precipitation. The alkaline enzyme was adsorbed on alumina gel leaving the acid enzyme in solution. The alkaline enzyme was recovered by elution with phosphate buffer. The acid enzyme was further purified by acetone and ethanol fractionation. The acid enzyme was purified about 65-fold on the basis of protein.

The brain alkaline enzyme had a pH optimum of 7.6-7.8. Magnesium ion was required for activity. All other divalent metal ions tested, except barium, inhibited the enzyme. The inhibitory effects were reversed by cysteine or ethylenediaminetetraacetic acid (EDTA) or both. The enzyme was inhibited by sulfhydryl reagents. The inhibition by p-chloromercuribenzoate was a linear function of concentration and was reversible by cysteine. Cysteine, glutathione, thioglycollate, and EDTA, activated the enzyme. Activation by low EDTA concentrations was due to removal of trace metal ion inhibitors. The mechanism of the activation by substrate-level concentrations is obscure. The brain enzyme exhibited zero-order kinetics to about 90 per cent hydrolysis. The kinetics of the reaction were examined over a range of magnesium ion and pyrophosphate concentrations and pH values. Excess magnesium ion did not inhibit, high magnesium-pyrophosphate concentrations inhibited, and excess pyrophosphate inhibited the reaction. A mechanism was proposed and the equation presented. When calculated according to the proposed mechanism the

value of  $K_m$  was  $1.7 \times 10^{-4}$  moles/l. and the value of  $V_m$  was 30 M P/hour.

The purified acid pyrophosphatase of potato exhibited first-order kinetics. It was inhibited by magnesium ion and was not affected by high concentrations of EDTA, sulfhydryl compounds, or sulfhydryl reagents. Substrate concentration-activity data were obtained at several values of pH. A  $K_m$  of  $4.8 \times 10^{-4}$  moles/l. was obtained.

The alkaline pyrophosphatases from liver, yeast, and brain required magnesium for activity and were activated by EDTA. Comparison of these enzymes with those from other organisms made clear the fact that the hydrolysis of pyrophosphate is carried out by enzymes of very diverse properties. The study of these enzymes would contribute greatly to the theory of enzymatic mechanisms. At present, however, the further purification of these enzymes is most desirable. Microfilm \$2.00; Xerox \$4.00. 73 pages.

## I. OXIDATIVE METABOLISM OF L-KYNURENINE AND 3-HYDROXYANTHRANILIC ACID BY MAMMALIAN LIVER.

### II. NUTRITIONAL STUDIES WITH THE HYPERTHYROID RAT.

(L. C. Card No. Mic 59-584)

Clarence Obadiah Stevens, Ph.D.  
University of Illinois, 1958

## SECTION I. OXIDATIVE METABOLISM OF L-KYNURENINE AND 3-HYDROXYANTHRANILIC ACID BY MAMMALIAN LIVER

Observations supporting the currently-accepted reaction sequence for the conversion of tryptophan to niacin, and other pyridine derivatives, in *Neurospora crassa* and mammals are summarized briefly.

Studies of urinary excretion patterns (Henderson, L. M., et al., J. Biol. Chem. 215, 369 (1955)) in normal (inattention control) and riboflavin-deficient rats following doses of L-tryptophan, L-kynurenine, 3-hydroxy-DL-kynurenine or 3-hydroxyanthranilic acid have led to the suggestion that riboflavin is involved in kynurenine hydroxylation. Therefore, hepatic kynurenine hydroxylase, a reduced triphosphopyridine nucleotide-dependent enzyme, was studied in mitochondria from inattention control and riboflavin-deficient rats. To obtain a valid comparison it was necessary to solubilize the enzyme system. Cholate treatment was more effective than digitonin treatment in this respect. Using cholate extracts from normal rat liver mitochondria, kinetic studies of the hydroxylation reaction were made. Specific activities of kynurenine hydroxylase in whole or cholate-disrupted mitochondria from riboflavin-deficient rats were 2- to 3-fold lower than in similar preparations from inattention control animals. Activity in mitochondrial preparations from riboflavin-deficient rats was not increased by the addition of flavin mononucleotide, flavin adenine dinucleotide or a boiled liver extract. Attempts to resolve possible flavin coenzymes were unsuccessful because of the enzyme's lability at low pH.

Hepatic 3-hydroxyanthranilic acid oxidase, another enzyme involved in the conversion of tryptophan to quinolinic acid, was studied in regard to possible activators and



purification procedures. Pre-incubation with  $10^{-4}$  M ferrous sulfate and  $10^{-3}$  M reduced glutathione was required to demonstrate maximal activity in crude, dialyzed, aged acetone powder extracts. Dependence of oxidase activity on sulfhydryl groups was indicated by inhibition with  $10^{-5}$  M p-chloromercuribenzoate,  $10^{-4}$  M mercuric chloride or  $10^{-4}$  M iodosobenzoate. Reduced glutathione, at  $10^{-3}$  M, reversed the inhibition caused by the first two agents. Iodoacetate or sodium cyanide, each at  $10^{-3}$  M, were not inhibitory.

Approximately 4-fold purification of the oxidase, with 86 to 90 per cent recovery of activity, was accomplished by the combined use of heat and lead subacetate treatments of acetone powder extracts.

The oxidative conversion of 3-hydroxyanthranilic acid to quinolinic acid via an unstable intermediate was studied in liver extracts from ten species. The major product of 3-hydroxyanthranilic acid oxidation in liver extracts from the mouse, pig, or rat, or in liver homogenates from the rat, was quinolinic acid. In cat liver extracts or homogenates, picolinic acid was the predominant product. The significance of this species difference has been discussed with respect to niacin synthesis by the cat.

## SECTION II. NUTRITIONAL STUDIES WITH THE HYPERTHYROID RAT

Nutritional stress aspects of hyperthyroidism, induced in the rat by administration of thyroid-active materials, are reviewed.

An improved curative assay is described for the substance(s) present in pork liver residue which reverses the growth suppression in rats caused by feeding diets containing low levels of iodinated casein (Protamone). The animals were fed 0.243 per cent Protamone for a 2-week period; then their growth rates were measured over a 3-week curative assay period during which the supplements to be tested were added to the Protamone-containing diet.

Cholesterol, corn oil or crystalline aureomycin stimulated growth slightly under these conditions. A combination of these three substances was almost as effective as 10 per cent pork liver residue alone. The liver residue plus these three substances supported growth and survival nearly equivalent to that obtained by removing Protamone from the diet.

Pork liver residue was the best source of the growth factor. The activity was only partially extracted by a mixture of chloroform and methanol (2:1), which removed most of the cholesterol present in pork liver residue.

Removal of iodinated casein from the diet lowered the basal metabolic rate and caused immediate resumption of growth. A liver residue active in stimulating growth did not markedly alter the basal metabolic rate or the susceptibility of hepatic mitochondria to swelling in a hypotonic medium. Growth stimulation by pork liver residue was shown to be primarily due to increased efficiency of food utilization. Microfilm \$2.95; Xerox \$10.20. 228 pages.

## CHEMISTRY, INORGANIC

### SOME METAL CONTAINING POLYMERS

(L. C. Card No. Mic 59-530)

Malcolm Lawrence Judd, Ph.D.  
University of Illinois, 1958

Several metal containing polymers, in which the metal ion is held in the polymer through coordinate bonds, were synthesized and their stability toward heat was determined.

If two chelating groups are so located in the ligand molecule that they cannot coordinate to the same metal ion, they may attach themselves to two different metal ions, thereby linking the metal ions together. By repetition of this process, long polymers can build up.

Linear polymers were prepared which contained either copper(II) or zinc(II) ions and the following tetrafunctional ligands: N,N-benzidinediacetic acid,  $\alpha,\alpha'$ -benzidinedisulfonic acid, 2,2-bis-(3-amino-4-hydroxyphenyl)-propane, bis-(3-amino-4-hydroxyphenyl)-sulfone, bis-(3-amino-4-hydroxyphenyl), bis-(8-hydroxy-5-quinolyl)-sulfone, bis-(8-hydroxy-5-quinolyl)-methane and bis-(8-hydroxy-5-quinolyl).

The general method of preparation consisted of mixing nonaqueous solutions of ligand and metal salt. The polymeric material precipitated from the solution; all polymers were obtained as highly insoluble drab colored powders. Due to this insolubility, the degree of polymerization could not be determined, but elemental analysis indicated a high degree of polymerization in some cases.

Of the compounds studied, the chelate polymers containing bis-(8-hydroxyquinolines) were the most thermally stable. The zinc complex of bis-(8-hydroxy-5-quinolyl)-sulfone was stable at temperatures in excess of  $300^{\circ}\text{C}$  when heated in an atmosphere of nitrogen. In general, those polymers containing zinc(II) ions were more stable to heat than the corresponding copper polymers. The decreased stability of the copper containing materials was ascribed to the variable valence of the copper atom which could conceivably cause catalytic decomposition of the complex.

The logarithms of the formation constants for the copper(II), nickel(II), and zinc(II) complexes of  $\beta$ -aminoglutaric acid were measured and found to be 6.78, 5.39 and 5.70 respectively.

A thermogravimetric balance, easily constructed from ordinary laboratory equipment, was designed.

Microfilm \$2.00; Xerox \$5.60. 114 pages.

### OBSERVATIONS ON THE RARE EARTHS: CHEMICAL AND ELECTROCHEMICAL STUDIES IN NON-AQUEOUS SOLVENTS

(L. C. Card No. Mic 59-579)

Dorian Sevcik Smith, Ph.D.  
University of Illinois, 1958

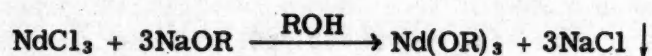
The first phase of this study dealt with rare earth chloride-alcohol systems. Several neodymium chloride alcoholates were prepared from the anhydrous materials; other techniques were also used. The compounds isolated



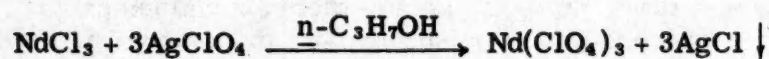
were  $\text{NdCl}_3 \cdot 4\text{CH}_3\text{OH}$ ,  $\text{NdCl}_3 \cdot 3\text{C}_2\text{H}_5\text{OH}$ ,  $\text{NdCl}_3 \cdot 3n\text{-C}_3\text{H}_7\text{OH}$ , and  $\text{NdCl}_3 \cdot 3n\text{-C}_4\text{H}_9\text{OH}$ . Solubilities of these materials in their corresponding alcohols were determined and x-ray diffraction patterns were recorded for the crystalline materials. From these, d-spacings were calculated.

The absorption spectrum of neodymium chloride in these alcohols (methanol, ethanol, n-propanol, n-butanol) was altered from solvent to solvent, with slight intensifications and wavelength displacements observed for certain peaks; occasional splitting of a single band into multiplets was noted. The absorption peaks tended to shift to shorter wavelengths in solvents of higher dielectric constant.

Metathetical reactions attempted in the alcohols indicated that neodymium alkoxides could not be produced in alcoholic solution according to the following equation because of coprecipitation of this material with sodium chloride.



However, an alcoholic solution of neodymium perchlorate was obtained by using a reaction which proceeds as follows:



Attempts to obtain a crystalline rare earth perchlorate were unsuccessful.

Conductivity studies on neodymium chloride in the alcohols indicated that this salt is a weak electrolyte in methanol and ethanol and becomes progressively weaker until in n-propanol and n-butanol it may be described as an extremely weak electrolyte. Attempts to electrodeposit neodymium metal directly from these solutions were unsuccessful; preferential hydrogen evolution occurred with the lower alcohols, and this was complicated by poor conductance behavior in the cases of n-propanol and n-butanol.

In the latter phase of this study, samarium and europium trivalent and divalent chlorides were investigated with emphasis on dimethylformamide (DMF) as a solvent. Electrolyses of samarium(III) chloride in DMF gave nothing but intense red-brown solvent reduction products. The same phenomena occurred in electrolyses of europium, gadolinium, and thorium chlorides in DMF. Samarium amalgam may be produced either electrolytically or chemically (using sodium amalgam) from solutions of its trichloride. Electrolyses of samarium(III) chloride were performed in tetrahydrofuran and acetonitrile, but no deposition of the rare earth metal resulted.

Compounds containing DMF of solvation were prepared; they are  $\text{ThCl}_4 \cdot 4\text{DMF}$  and  $\text{NdBr}_3 \cdot 8\text{DMF}$ . The corresponding chloride of the latter compound could not be prepared, presumably because the chloride ion is too small for the necessary lattice requirements. A DMF solution of neodymium thiocyanate was prepared according to the equation:



A crystalline product could not be obtained from this solution.

Conductance and electrolysis studies on strontium chloride in DMF indicated that this salt is a weak electrolyte; however, its extensive solubility permits a conducting solution to be obtained. Electrolyses using various metal

electrodes resulted in deposition of amorphous strontium-containing material; electrolysis using a mercury cathode gave strontium amalgam. Europium(II) chloride is only very slightly soluble in DMF, and thus resembles slightly soluble barium chloride more than strontium chloride in this respect. Europium(II) chloride proved to be essentially insoluble in dimethylformamide, tetrahydrofuran, ethanol, and acetonitrile. It did dissolve in ethanolamine but gave a very poorly conducting solution; a solution in ethylene glycol was a good conductor, but electrolysis gave no metal deposition. Perhaps the best solvent for europium(II) chloride was methanol; however, electrolysis gave only hydrogen evolution.

Spectra of samarium(III) and europium(III) chlorides in DMF exhibit marked intensification of the major absorption peaks, indicating pronounced association of DMF with rare earth ions. The spectrum of europium(II) chloride in acetonitrile was recorded. Examination of the spectrum of anhydrous europium(III) chloride indicates that perhaps a very small amount of the divalent material is present in the compound. Microfilm \$2.00; Xerox \$6.00. 123 pages.

#### A STUDY OF THE REACTIONS OF DICOBALT OCTACARBONYL AND COBALT HYDROCARBONYL WITH ALIPHATIC CONJUGATED DIENES IN RELATION TO THE MECHANISM OF THE HYDROFORMYLATION (OXO) REACTION

(L. C. Card No. Mic 59-621)

Robert Inman Stearns, Ph.D.  
Tulane University, 1958

Chairman: Hans B. Jonnasen

Attempts to prepare and isolate complexes of dicobalt octacarbonyl with the aliphatic conjugated dienes, butadiene, isoprene, and biisopropenyl, were made without success. Solutions of dicobalt octacarbonyl in butadiene, isoprene, and biisopropenyl were prepared under a blanket of either nitrogen or carbon monoxide, and were allowed to stand for various lengths of time during which evolution of gas was noted.

Solids were isolated from these solutions either by evaporation to dryness or cooling to cause precipitation. The solids proved in all cases to be slightly contaminated dicobalt octacarbonyl.

Spectrophotometric studies in the visible wave length region gave no indication of any complex formation between dicobalt octacarbonyl and isoprene.

Dicobalt octacarbonyl in n-heptane containing isoprene decomposed by loss of carbon monoxide to tetracobalt dodecacarbonyl faster than dicobalt octacarbonyl in n-heptane.

It was also found that at elevated temperatures dicobalt octacarbonyl catalyzes the polymerization of isoprene while it itself undergoes decomposition by the loss of carbon monoxide.

Complexes were prepared by directly combining various dienes with cobalt hydrocarbonyl. Other methods involving the preparation of the cobalt hydrocarbonyl *in situ* from either zinc cobalt carbonylate or potassium cobalt carbonylate were devised.



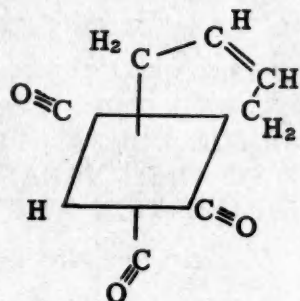
The best yields were obtained by placing an aqueous solution of potassium cobalt carbonylate in a high pressure reaction vessel. A smaller bottle containing a solution of the diene in glacial acetic acid was then lowered into the reaction vessel without mixing the two solutions. The vessel was swept with nitrogen, closed and rocked at room temperature for at least twelve hours during which time mixing occurred. The reaction mixture, which was removed under nitrogen, consisted of two layers.

The liquid complexes in the dark organic layers were purified by distillation. The butadiene complex boiled at 33-35° (0.5 mm.); the isoprene complex at 35-38° (0.5 mm.) and the biisopropenyl complex at 39-40° (0.5 mm.).

Based on elemental analyses and molecular weight determinations the butadiene complex has the molecular formula  $\text{HCo}(\text{CO})_3\text{C}_4\text{H}_6$  and the biisopropenyl complex  $\text{HCo}(\text{CO})_3\cdot\text{C}_6\text{H}_{10}$ .

The isoprene complex was also prepared but because of contamination by isoprene polymer duplicate analytical results could not be obtained.

Nuclear magnetic resonance studies indicate that the following structure can be postulated for the butadiene complex.

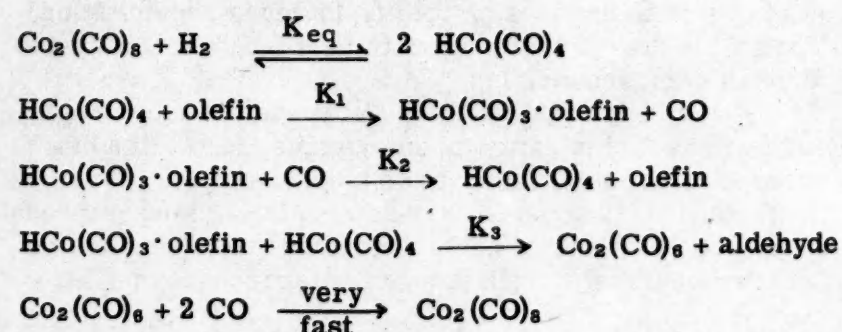


The infrared spectrum of the complex is compatible with the proposed structure.

The similarity of the infrared spectra of the complexes indicate analogous structures for the isoprene and biisopropenyl complexes.

By analogy to the complexes prepared, it is postulated that the intermediate formed in the hydroformylation reaction is  $\text{HCo}(\text{CO})_3\cdot\text{olefin}$ , in which the interaction of an empty  $\text{sp}^3$  orbital of cobalt with the electron pair from the  $\pi$  cloud of the olefin is present.

The following reactions are proposed as the mechanism of the hydroformylation reaction.



From these equations the following kinetic expression is derived.

$$\text{initial rate} = \frac{K_{eq}K_1K_3P_{\text{H}_2}[\text{olefin}][\text{Co}_2(\text{CO})_8]}{K_2P_{\text{CO}} + K_3\sqrt{K_1P_{\text{H}_2}}[\text{Co}_2(\text{CO})_8]}$$

The experimental observations about the rate of hydroformylation can best be explained by this new mechanism.

Microfilm \$2.00; Xerox \$4.60. 87 pages.

# A STUDY OF THE ELECTRONIC CONFIGURATION $d^4$ ; THE MAGNETIC AND SPECTRAL PROPERTIES OF HEXAHALOOSMATE (IV) COMPLEXES

(L. C. Card No. Mic 58-7997)

Almon George Turner, Jr., Ph.D.  
Purdue University, 1958

Major Professor: Dr. Alan F. Clifford

The primary purpose of the research described in this thesis was to investigate the magnetic properties of the hexafluoro-, hexachloro-, and hexabromoosmate (IV) ions, together their infra-red and visible spectral properties and on the basis of these data to explain the observed visible spectra of these materials, their anomalous magnetic moments, and their temperature-independent paramagnetic susceptibilities.

By measuring the magnetic susceptibilities from 77 to 360°K, it was found that in each of these materials spin orbit coupling made a large contribution to the magnetic moment and in doing so accounted very satisfactorily for the observed low magnetic moments of these materials. [M. Kotani, J. Phys. Soc. Japan, 4, 293 (1949)].

When the effects of this spin orbit coupling on the electronic energy levels was considered, along with ligand field theory [L. E. Orgel, J. Chem. Phys. 23, 1004 (1955) and J. Richardson, Ph.D. Thesis, Iowa State College, 1956] a semi-quantitative explanation of the visible and infra-red spectra was obtained for  $\text{K}_2\text{OsCl}_6$  and  $\text{K}_2\text{OsBr}_6$ . The spectral and magnetic behavior of  $\text{K}_2\text{OsF}_6$  could not be entirely accounted for on the basis of spin orbit coupling alone.

The effects of the splitting due to the ligand field in these materials was found to decrease in the expected manner with  $Dq$  for  $\text{K}_2\text{OsF}_6$  equal to  $5000 \text{ cm}^{-1}$ ,  $Dq$  for  $\text{K}_2\text{OsCl}_6$  equal to  $2900 \text{ cm}^{-1}$ , and  $Dq$  for  $\text{K}_2\text{OsBr}_6$  equal to  $2500 \text{ cm}^{-1}$ .

A set of experiments is described which showed that the magnetic moments of these materials could not be altered by irradiating the samples with visible light during the magnetic measurements. Since the magnetic moment did not change upon irradiation with light containing the frequencies of the peaks in the visible spectrum, these transitions cannot be the ones, which determine the magnetic moment. Although coupling accounts nicely for this magnetic behavior, the results of ligand field theory are necessary to obtain an explanation of the magnetic moment and the visible spectrum.

In the course of this research crystal structure determinations were made on  $\text{K}_2\text{OsCl}_6$  and  $\text{K}_2\text{OsBr}_6$ . They were found to possess the face centered cubic potassium hexachloroplatinate structure belonging to symmetry group  $O_h^5 - m3m$ . Potassium hexachloroosmate (IV) had a cell edge of  $9.82 \pm 0.01 \text{ \AA}$  and the corresponding bromoosmate had a cell edge of  $10.37 \pm 0.02 \text{ \AA}$ . Potassium hexafluoroosmate (IV)



was found to fit best the hexagonal crystal system. No other crystal forms of  $K_2OsF_6$  of higher symmetry were found at temperatures below its decomposition point in air.

In order to measure accurately the magnetic susceptibilities a magnetically compensated quartz beam microbalance was employed [A. Czanderna and J. M. Honig, *Anal. Chem.* **29**, 1206 (1957)] and its modifications, construction, calibration, and operation are described. It had a sensitivity of  $5 \times 10^{-8}$  grams and was very rugged, possessing many advantages over the usual quartz helix-type of apparatus.

The details of design and construction of an electromagnet which operates at the 20 kilowatt level and produces a field of 11,600 gauss using a two inch pole gap are given. The magnet was so designed that it could be used for either Faraday- or Guoy-type magnetic susceptibility measurements.

The construction of a proton resonance fluxmeter is described [N. J. Hopkins *Rev. Sci. Inst.* **20**, 401 (1949)] together with operational details.

Microfilm \$2.05; Xerox \$7.20. 153 pages.

## CHEMISTRY, ORGANIC

### REACTIONS OF OPTICALLY ACTIVE INDOLE MANNICH BASES

(L. C. Card No. Mic 59-463)

Jay Donald Albright, Ph.D.  
University of Illinois, 1958

The usefulness of carbon-carbon alkylation reactions with indole Mannich bases has been well established. The synthesis of tryptophan and derivatives of tryptophan has been one of the important applications of alkylation reactions with Mannich bases of indole. Although the synthetic aspects of these alkylation reactions have been studied thoroughly, the mechanism of the reactions has not been elucidated. A 3H-pseudoindole has been postulated as an intermediate and indirect evidence has been found for the intermediate 3-methylene-3H-pseudoindole in alkylations with gramine. Additional data are needed to establish a 3H-pseudoindole as an intermediate in alkylations with indole Mannich bases and to determine the exact mechanism of the reaction. The purpose of this work was to find additional evidence for a 3H-pseudoindole in carbon-carbon alkylation reactions and to find additional information about the mechanism.

If a 3H-pseudoindole is an intermediate in alkylations with Mannich bases of indole, racemic products should be obtained from optically active 3-(isopropylaminoethylidene)-indole. The separation of 3-(isopropylaminoethylidene)-indole into its optical isomers was therefore carried out. From the alkylation of diethyl malonate and diethyl acetamidomalonate with optically active 3-(isopropylaminoethylidene)-indole were obtained racemic diethyl (3-indolylethylidene)-malonate and diethyl (3-indolylethylidene)-acetamidomalonate, respectively. 3-(Piperidinoethylidene)-indole and 3-(methoxyethylidene)-indole were prepared from optically active 3-(isopropylaminoethylidene)-indole and found to be racemic.

The preparations of 3-(methoxyethylidene)-indole, 3-(ethoxyethylidene)-indole and 3-(isopropoxyethylidene)-indole from 3-(dimethylaminoethylidene)-indole were effected.

3-Benzylidene-2-methyl-3H-pseudoindole was condensed with diethyl malonate. The addition of piperidine and ethanol to 3-benzylidene-2-methyl-3H-pseudoindole was accomplished.

3-(Dimethylaminoethylidene)-N-methylindole was prepared from acetaldehyde, dimethylamine and N-methylindole and its optical isomers were separated. Alkylation of diethyl acetamidomalonate with optically active 3-(dimethylaminoethylidene)-N-methylindole gave racemic diethyl (3-N-methylindolylethylidene)-acetamidomalonate. Basic hydrolysis of diethyl (3-N-methylindolylethylidene)-acetamidomalonate followed by decarboxylation yielded 2-acetamido-3-(3-N-methylindolyl)-butyric acid. The amino acid, 2-amino-3-(3-N-methylindolyl)-butyric acid, was obtained upon basic hydrolysis of the acetyl group of 2-acetamido-3-(3-N-methylindolyl)-butyric acid.

In the presence of sodium methoxide and piperidine 3-(piperidinomethyl)-indole and 3-(piperidinoethylidene)-indole were obtained from 3-(methoxymethyl)-indole and 3-(ethoxyethylidene)-indole, respectively. Attempts to carry out a carbon-carbon alkylation reaction with diethyl malonate and 3-(methoxymethyl)-indole were unsuccessful.

A preliminary kinetic study of the reaction of diethyl malonate with 3-(isopropylaminoethylidene)-indole was carried out. The rate of the reaction was determined by titration with 0.1 N hydrochloric acid of the isopropylamine eliminated and by following the rate of racemization (polarimetric method). Under identical reaction conditions the rates found by the two methods were identical. When the isopropylamine eliminated was not removed from the reaction mixture, the rate of racemization increased; the reaction appeared to be autocatalytic.

Pseudo first-order kinetics were observed; however, the rate of the reaction depended on the initial concentration of the 3-(isopropylaminoethylidene)-indole. Two mechanisms are suggested which would explain both the fact that pseudo first-order kinetics were obtained for any given initial concentration of 3-(isopropylaminoethylidene)-indole and the fact that the overall rate depended on the initial concentration of 3-(isopropylaminoethylidene)-indole. It was also determined that the rate of the reaction depended on the concentration of catalyst. The results of the kinetic study are rationalized in terms of the suggested mechanism. Microfilm \$2.00; Xerox \$5.20. 101 pages.

### STUDIES OF NUCLEOPHILIC SUBSTITUTION IN HINDERED AROMATIC KETONES. A NEW ROUTE TO THE *o*-TERPHENYLS.

(L. C. Card No. Mic 59-464)

Robert Lee Albright, Ph.D.  
University of Illinois, 1958

A new synthetic route to *o*-terphenyls has been developed. It is especially valuable for substituted *o*-terphenyls and in particular for those having substituents in the 2- and 2"-positions. The method is illustrated by the preparation of 2-duroyl-*o*-terphenyl by the condensation of



2-biphenylmagnesium iodide with duryl *o*-methoxyphenyl ketone. The product was obtained in a 51.2% yield.

The primary achievement of the present study, however, was the extension of the scope of the synthesis to include 2,2"-disubstituted-*o*-terphenyls. For this purpose were needed 2-biphenylmagnesium halides carrying in the 2'-position substituents which are tolerated by the organo-magnesium function. A method for getting such compounds emerged from a study of the action of nucleophiles on the biphenyleneiodonium ion. The nucleophiles employed in this study were bromide, benzoate, methoxide, and acetate.

Experiments with bromide, methoxide, and acetate led to products that were identified. Bromide ion gave biphenyleneiodonium bromide. Methoxide ion in refluxing methanol did not yield any of the desired methoxy iodide. The compounds actually obtained were biphenyl (11.61%), 2-iodobiphenyl (56.7%), and 2,2'-diiodobiphenyl (5.35%). In addition 20.4% of the starting material was recovered in the form of biphenyleneiodonium chloride.

Experiments with benzoate ion, perhaps because of failure to find the proper solvent, were unrewarding. With the acetate ion in refluxing glacial acetic acid, however, displacement proceeded smoothly. Moreover, this displacement was found to be catalyzed by cupric ion and, under the most favorable conditions, gave nearly quantitative yields of the iodo acetate. The acetate was converted by methanolysis to the corresponding phenol, methylation of which in turn gave the methoxy iodide. The methoxy iodide formed the Grignard reagent, 2-methoxy-2'-biphenylmagnesium iodide, as was shown by carbonation; the product was the known 2-carboxy-2'-methoxybiphenyl. The presence of the methoxyl group in the 2'-position had no untoward effect on the condensation of this Grignard reagent with duryl *o*-methoxyphenyl ketone. The reaction took place readily to give 2-duroyl-2"-methoxy-*o*-terphenyl in an 81.2% yield.

A very remarkable reduction has been observed in the reaction of methyl *o*-duroylbenzoate with methylmagnesium iodide. The isopropenyl ketone, normal product of this reaction, was not obtained. Very surprisingly, the saturated ketone, duryl *o*-isopropylphenyl ketone was produced instead. If it is assumed that the isopropenylphenyl ketone is formed as an intermediate, the change might be designated as a 1,6-reduction of an unsaturated ketone.

A bimolecular reduction product formed by the action of metallic sodium on the olefinic ketone was thought by Hess to be a 2,5-disubstituted hexane derivative. An attempt to prepare this bimolecular reduction product from the di-Grignard reagent of 2,5-dibromohexane and duryl *o*-methoxyphenyl ketone gave instead 2,2'-diduroylbiphenyl.

2,4-Diduroylbromobenzene has been prepared in a four-step synthesis from *m*-xylene. By the action of sodium methoxide and sodium phenoxide it has been converted, respectively, to the corresponding derivatives of anisole and phenyl ether.

A study has been made of the action of Grignard reagents on the bromo diketone, the methoxy diketone, *o*-dimesitoylbenzene, and 1,4-dimesitoylnaphthalene. With the methyl and phenyl reagents the bromo diketone yields, respectively, the corresponding dimethyl and diphenyl derivatives. The behavior of the methoxy diketone was similar. By working under nitrogen, it was possible to isolate what appears to be 1,3-diduroyl-4,6-diphenylcyclohexadiene by the reaction of phenylmagnesium bromide with the bromo diketone.

With *o*-dimesitoylbenzene and the phenyl reagent a keto

alcohol was obtained which appears to be 2,4,6-trimethyl-2'-(*o*-hydroxy-2,4,6-trimethylbenzyl)-benzophenone.

The action of the phenyl Grignard reagent on 1,4-dimesitoylnaphthalene, likewise, affords a reduction product. This compound appears to be a dihydronaphthalene derivative, however, for dehydrogenation with chloranil converts it to the parent compound, 1,4-dimesitoylnaphthalene.

Microfilm \$2.00; Xerox \$6.60. 140 pages.

#### A REACTION RATE STUDY OF SOME SUBSTITUTED 4-CHLOROQUINOLINES

(L. C. Card No. Mic 59-43)

Roy Horton Bailey, Ph.D.

The University of North Carolina, 1958

Supervisor: R. L. McKee

The rates of piperidinolysis of 4-Chloroquinoline and some of its *bz*-substituted methyl and chloro derivatives were determined, the reaction being of pseudo-first order. It was found that although log *PZ* factors are not constant they are linear functions of energies of activation for a given family of substituents. This permits the application of a Hammett equation correlation, the kinetics being described best with the sigma substituent values of Illuminati and a rho reaction constant of 5.76.

Microfilm \$2.00; Xerox \$4.40. 82 pages.

#### EPOXIDATION STUDIES OF RESIN ACIDS AND SELECTED DERIVATIVES

(L. C. Card No. Mic 58-5112)

William Charles Bailey, Jr., Ph.D.

Emory University, 1957

The results of the research are summarized in the following statements:

- (1) A homogeneous dihydroabietic acid has been obtained from abietic acid using the Birch reduction.
- (2) Epoxidations have been conducted using this model dihydroabietic acid to obtain an epoxide in high yield.
- (3) Experimental results have been obtained in sufficient detail to assign a tentative structure to this epoxide.
- (4) Using the best experimental conditions obtained in model studies, epoxidations of selected resin acids and their derivatives have been accomplished; the products are characterized.

Microfilm \$2.00; Xerox \$3.80. 70 pages.



THE ORTHO SUBSTITUTION REARRANGEMENT  
OF ORTHO, META, AND PARA SUBSTITUTED  
BENZYLTRIMETHYLAMMONIUM IONS AND OF  
CERTAIN SUBSTITUTED DIBENZYL-  
DIMETHYLAMMONIUM IONS

(L. C. Card No. Mic 59-992)

William Quinby Beard, Jr., Ph.D.  
Duke University, 1959

Supervisor: Charles R. Hauser

A study was made primarily of the ortho substitution rearrangement of various ortho, meta, and para substituted benzyltrimethylammonium ions with sodium amide in liquid ammonia. Several dibenzyltrimethylammonium ions were also rearranged with the same reagent.

The p-methyl and p-isopropyl benzyltrimethylammonium ions underwent the rearrangement in respective yields of 63% and 92%. The o-methyl and o-ethyl quaternary ions had previously been shown to rearrange in 64% and 90% yields respectively. However, the p-benzyl and o-benzyl quaternary ions failed to produce any rearranged amine. These ions yielded only amorphous hydrocarbon material, which appeared to arise from elimination through the aromatic ring.

The p-methoxy, o-methoxy, and p-chloro benzyltrimethylammonium ions rearranged in yields of 89%, 75%, and 54% respectively, but the p-hydroxy, p-cyano, and o-chloro quaternary ions were unchanged by sodium amide in liquid ammonia. The o-chloro quaternary ion rearranged in 45% yield when the ammonia was replaced by ether.

The tertiary amines obtained from the rearrangement of the p-methoxy and p-isopropyl quaternary ions were converted to their methiodides. These methiodides were further rearranged around the aromatic ring.

In contrast to the o-benzyl and p-benzyl isomers the m-benzylbenzyltrimethylammonium ion produced a rearranged amine in 22% yield which was unaccompanied by elimination products. The m-methyl, m-methoxy, and m-chloro quaternary ions underwent the course of rearrangement involving substitution into the position para to the substituent in the aromatic ring to form the corresponding tertiary amines in respective yields of 82%, 92%, and 16%. With the latter two ions the possible rearrangement into position ortho to the substituent appeared to occur to a small extent.

The results with the meta substituted quaternary ammonium ions are of particular interest not only because of the two possible courses of orientation, but also because they do not appear to support the current mechanism for the rearrangement, in which the aromatic ring is considered to function as an electron acceptor. A new mechanism in which the aromatic ring functions as an electron donor is suggested.

The structures of all but two of the tertiary amines obtained from the rearrangements described above were established by oxidation to the corresponding benzoic and phthalic acids or by independent syntheses. These and other synthetic aspects of the ortho substitution rearrangement are discussed. The syntheses of the benzyltrimethylammonium salts, which were used as starting materials and most of which are new compounds, are described.

The bis(p-methoxybenzyl)dimethylammonium ion, the bis(p-chlorobenzyl)dimethylammonium ion, and the bis-(p-

cyanobenzyl)dimethylammonium ion were rearranged by sodium amide in liquid ammonia to the corresponding amines in yields of 73%, 21%, and 11% respectively, but the bis(o-chlorobenzyl)dimethylammonium ion failed to yield an isolable rearranged amine. The unsymmetrical benzyl-o-chlorobenzyltrimethylammonium ion rearranged in 38% yield to an amine with a structure corresponding to substitution into the unsubstituted aromatic ring. Its structure was established by an independent synthesis.

Microfilm \$2.00; Xerox \$6.60. 137 pages.

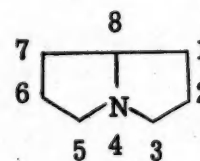
AN APPROACH TO THE SYNTHESIS  
OF THE NECINES RELATED TO  
THE SENCIO ALKALOIDS

(L. C. Card No. Mic 58-5115)

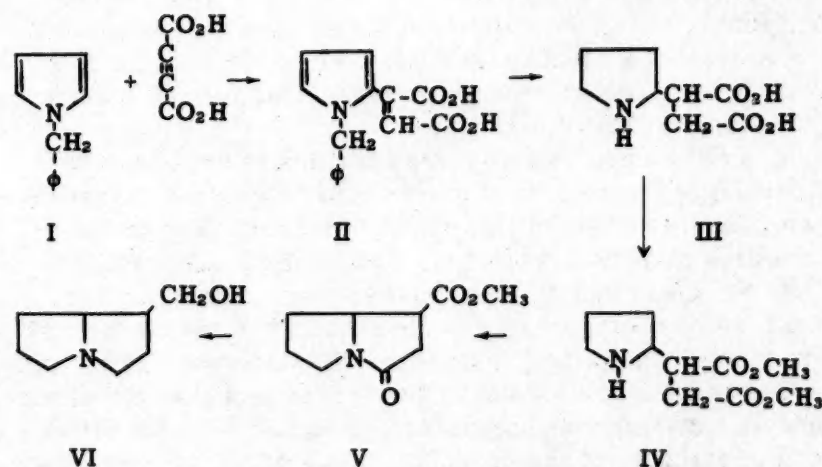
Wesley Alva Blanchard, Ph.D.  
Emory University, 1957

Senecio, the largest genus belonging to the Compositae family, comprises over one thousand species, and most of these contain certain alkaloids referred to as "Senecio alkaloids."

The Sencio alkaloids undergo alkaline hydrolysis to give the necine and necic acid moieties which constitute the parent alkaloid. The most common necines isolated are retronecine, heliotridane and platynecine, all of which are structurally similar. The basic ring system of the above mentioned necines is that of pyrrolizidine, as shown below:



A survey of the reported syntheses of pyrrolizidines shows that no general synthesis is available which can be adapted to the synthesis of the necines related to Senecio alkaloids. The purpose of this investigation was to develop a new pyrrolizidine synthesis that could be adapted for this purpose. The general scheme which was investigated is shown below:



A second objective, unforeseen at the outset of the work, was to investigate the reaction of N-benzylpyrrole with



various dieophiles. The results of this investigation are discussed in the following paragraph.

N-Benzylpyrrole, when treated with maleic anhydride, afforded an adduct which was tentatively identified as N-benzylpyrrole-2-succinic anhydride. The yield was low, thus discouraging further work as a starting point for the general synthesis described above.

N-Benzylpyrrole, when treated with acetylenedicarboxylic acid, afforded N-benzylpyrrole-2-fumaric acid, N-benzylpyrrole-2-maleic anhydride and a third compound tentatively identified as 7-benzyl-7-azabicyclo[2.2.1]hept-2,5-diene-2,3-dicarboxylic acid by its solubility behavior, neutral equivalent, infrared spectrum and hydrogenation products.

N-Benzylpyrrole, on treatment with methyl acetylenedicarboxylate, afforded methyl N-benzyl-8,9-dihydroindole-4,5,6,7-tetracarboxylate which was oxidized to methyl N-benzylindole-4,5,6-tricarboxylate and hydrolyzed to the corresponding triacid.

N-Benzylpyrrole-2-fumaric acid and N-benzylpyrrole-2-maleic anhydride were reduced with hydrogen and converted directly into methyl pyrrolidine-2-succinate. Preliminary studies on the cyclization of this ester to the pyrrolizidine ring system met with little success. Further work is recommended along these lines.

Microfilm \$2.00; Xerox \$4.00. 66 pages.

#### ELIMINATION REACTIONS OF VINYL CHLORIDES AND ETHYLENE DICHLORIDES

(L. C. Card No. Mic 59-822)

Robert Stewart Bly, Jr., Ph.D.  
University of Colorado, 1958

Supervisor: Professor Stanley J. Cristol

In order to investigate the mechanisms of elimination reactions in diastereoisomeric systems, the dehydrochlorination rates of *meso* and *dl*-stilbene dichlorides were determined with excess sodium hydroxide in 92.6 wt. % ethanol. The reactions were shown to be first-order in base and first-order in dichloride. At 43° the rate of dehydrochlorination of the *dl*-dichloride, which yielded 1-chloro-*trans*-1,2-diphenylethene, was eight times faster than that of the *meso* compound which gave the *cis* isomer. The energy of activation was 4.2 kcal./mole less for the *dl*-dichloride, but the *meso* compound had a much more favorable entropy of activation.

The difference in activation energies is explained by considering the amount of steric crowding in the transition state. In a reaction of this type the steric effect in the transition state is always less than in the final product. Since the *meso* and *dl*-dichlorides are of approximately equal stability, the difference in stability of the two transition states can not be greater than the difference in stability of the products, or 5.5 kcal./mole. The fact that the difference in activation energy is nearly as large as the difference in stability of the products, must therefore mean that the transition states resemble the products in their geometric requirements. Such criteria are best met by *trans* E2-concerted transition states.

The difference in the entropies of activation of the two

compounds is explained by considering the "effective internal symmetry number" or the number of equivalent conformations available to each of the compounds in the ground state and in the transition state. The change in the "effective internal symmetry number" in going from the ground state to the transition state is shown to parallel the observed entropy change in this and in similar reactions in related compounds.

Cristol and Helmreich have shown that the phenyllithium-induced dehydrohalogenation of *trans*-1-bromo-2-phenylethene occurs at a rate two to six times that of the corresponding reaction in the *cis* isomer. They demonstrated that the reaction is first-order in each of the reactants. To account for these observations they proposed an  $\alpha$  elimination mechanism. They noted, however, that the same product would have been formed if  $\beta$  elimination had taken place, and therefore they could not rule out the latter possibility.

In order to extend these measurements to systems in which there could be no ambiguity about the course of the elimination, the rates of dehydrochlorination of the three isomeric chlorodiphenylethenes were determined with both sodium hydroxide in 92.6 wt. % ethanol and with phenyllithium in *n*-butyl ether. The reactions were shown to be first-order in base and first-order in chloro compound. The rates of the sodium hydroxide-initiated dehydrochlorinations were much slower than those initiated by phenyllithium. With sodium hydroxide, both chlorostilbenes gave tolan as the reaction product. The rate of *trans* elimination was greater than the rate of *cis* elimination. This order of reactivity is explained by means of the well-established *trans*-concerted elimination (in the case of the *trans* isomer) and a multi-step, *cis* elimination (in the case of the *cis* isomer). The rate of chloride-ion-liberation was much slower with 2-chloro-1,1-diphenylethene and sodium hydroxide. Although the product of this latter reaction was not determined, it must be concluded that if an  $\alpha$  elimination occurred, it did so at a much slower rate than either of the  $\beta$  eliminations.

With phenyllithium in *n*-butyl ether, the order of reactivity of the three chlorodiphenylethenes is reversed so that  $k_{\alpha} > k_{\text{cis-}\beta} > k_{\text{trans-}\beta}$ . In order to explain the facile phenyllithium-induced  $\alpha$  elimination, a mechanism is proposed which involves a five-membered cyclic transition state. This route is in agreement with the *trans*-phenyl migration observed by Flynn and with the energy and entropy of activation found in this work. As a result of the similarity of these energies and entropies of activation, a six-membered cyclic transition state is proposed for the phenyllithium-induced *cis* elimination. A concerted mechanism similar to that of the sodium hydroxide-initiated reaction is suggested for the *trans* elimination.

Microfilm \$2.75; Xerox \$9.40. 209 pages.



REARRANGEMENTS OF THE  
BICYCLO[2.2.2]OCTANE SYSTEM

(L. C. Card No. Mic 59-823)

Ruta Kramins Bly, Ph.D.  
University of Colorado, 1958

Supervisor: Professor Stanley J. Cristol

In order to study further the mechanisms of elimination reactions in rigid bicyclic systems, the preparation of the *cis* and *trans* isomers of bicyclo[2.2.2]octane-2,3-diol and of dibenzobicyclo[2.2.2]octadiene-2,3-diol was attempted.

Bicyclo[2.2.2]octane-*cis*-2,3-diol was prepared via the Diels-Alder reaction of vinylene carbonate and 1,3-cyclohexadiene and subsequent hydrogenation and hydrolysis of the adduct. Dibenzobicyclo[2.2.2]octadiene-*cis*-2,3-diol was prepared via permanganate oxidation of dibenzobicyclo[2.2.2]octatriene.

Attempts to prepare the corresponding *trans* diols were unsuccessful because of a rearrangement of the bicyclo[2.2.2]octane to the bicyclo[3.2.1]octane system. This rearrangement was encountered in acidic and alkaline media.

Treatment of dibenzobicyclo[2.2.2]octatriene with performic acid followed by hydrolysis gave dibenzobicyclo[3.2.1]octadiene-*exo*-4-*syn*-8-diol. The skeletal structure of this material was established by means of a permanganate oxidation which gave 3,3'-spirobipthalide and 3-(*o*-carboxyphenyl)phthalide as the principal products. The *exo*-4-*syn*-8 configuration of the hydroxyl groups was indicated by the infrared spectrum (which showed an intramolecular hydrogen bond) and by the fact that a cyclic carbonate could be prepared.

Dibenzobicyclo[2.2.2]octadiene-2,3-epoxide was prepared by the oxidation of dibenzobicyclo[2.2.2]octatriene with perbenzoic acid. The structure of the epoxide was confirmed by reduction with lithium aluminum hydride and comparison of the resulting dibenzobicyclo[2.2.2]octadiene-11-ol with an authentic sample. Reaction of the epoxide with formic acid followed by hydrolysis gave dibenzobicyclo[3.2.1]octadiene-*exo*-4-*syn*-8-diol.

Rearrangement also occurred when bicyclo[2.2.2]octene was treated with performic acid. In this case the product is probably bicyclo[3.2.1]octane-*exo*-4-*syn*-8-diol.

An attempt to prepare dibenzobicyclo[2.2.2]octadiene-*trans*-2,3-diol by the reaction of dibenzobicyclo[2.2.2]octadiene-2,3-epoxide with alkali in ethylene glycol, yielded 1,2,5,6-dibenzocycloheptatriene and an unknown acid. Several mechanisms were considered to account for the products but were ruled out when treatment of the presumed intermediates or related compounds with alkali did not result in the expected rearrangement.

On the basis of the available experimental evidence the rearrangement could best be explained in the following manner. First the C<sub>5</sub>-C<sub>6</sub> bond migrates to give an intermediate dipolar ion of the bicyclo[3.2.1]octadiene system which then immediately undergoes ring opening to give 1,2,5,6-dibenzocycloheptatriene-7-carboxaldehyde. In the presence of alkali the aldehyde undergoes hydrolytic cleavage to give 1,2,5,6-dibenzocycloheptatriene. The feasibility of this reaction path was demonstrated by heating the epoxide in the absence of alkali and isolating the 1,2,5,6-dibenzocycloheptatriene-7-carboxaldehyde. The structure of the aldehyde was demonstrated by reduction with lithium aluminum hydride followed by dehydration to give 1-meth-

ylene-2,3,6,7-dibenzocycloheptatriene. This is a known compound and was compared with an authentic sample. When treated with alkali in ethylene glycol the aldehyde cleaved to give the expected 1,2,5,6-dibenzocycloheptatriene.

1,2,5,6-Dibenzocycloheptatriene-7-carboxaldehyde was also obtained by rearrangement of dibenzobicyclo[2.2.2]octadiene-2,3-epoxide on activated alumina and by the treatment of dibenzobicyclo[3.2.1]octadiene-*exo*-4-*syn*-8-diol with acid.

The labile nature of the bicyclo[2.2.2]octane system made the synthesis of the *trans* diols impossible. A comparison was made of the rates of reaction of the di-*p*-bromobenzenesulfonates of bicyclo[2.2.2]octane-*cis*-2,3-diol and bicyclo[3.2.1]octane-*exo*-4-*syn*-8-diol with sodium *t*-butoxide. Results were complicated by the fact that in addition to the elimination of *p*-bromobenzenesulfonic acid other reactions took place, which resulted in a larger than expected decrease in base concentration.

Microfilm \$2.00; Xerox \$6.40. 134 pages.

## STUDIES OF HYDROXYMETHYLENE KETONES

(L. C. Card No. Mic 58-5118)

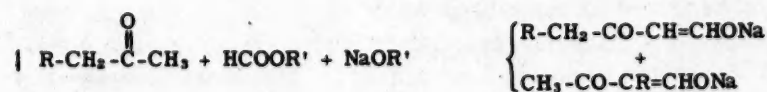
Kent Combs Brannock, Ph.D.  
Emory University, 1954

On treatment of the sodium salts of hydroxymethylene ketones, R-CO-CH=CHONa, with methanolic hydrogen chloride the corresponding  $\beta$ -ketoacetals, R-CO-CH<sub>2</sub>-CH(OCH<sub>3</sub>)<sub>2</sub>, were obtained. On similar treatment, sodium salts of the type R-CO-CR'=CHONa gave mixtures of the  $\beta$ -ketoacetals, R-CO-CHR'-CH(OCH<sub>3</sub>)<sub>2</sub> and the methoxymethylene ketones, R-CO-CR'=CHOCH<sub>3</sub>. The sodium salts of hydroxymethylene cyclohexanone and hydroxymethylene acetophenone gave only the methoxymethylene ketones under the same experimental conditions.

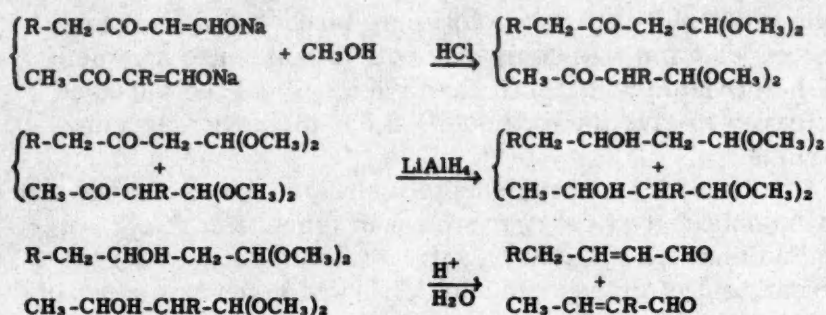
The  $\beta$ -ketoacetals have been shown to be similar to  $\beta$ -ketoesters in that they are readily cleaved by aqueous base to formic acid, methanol, and the ketone from which the hydroxymethylene ketone was originally derived. On the other hand it was found that  $\beta$ -ketoacetals cannot be alkylated as can  $\beta$ -ketoesters, apparently due to the ready elimination of methanol from the  $\beta$ -ketoacetal under the influence of bases. It was shown that methoxymethylene ketones can be obtained in good yield by elimination of methanol from the  $\beta$ -ketodimethylacetals by distillation of the latter from a catalytic amount of base.

The direct alkylation of sodium hydroxymethylene acetone as a route to methoxy or ethoxymethylene acetone was shown to be quite unsatisfactory, due at least in part to simultaneous carbon and oxygen alkylation.

Contrary to previous reports, it was shown that both methyl and methylene condensation occur in the reaction of formate esters with the unsymmetrical ketones, 2-butanone and 2-pentanone. This was shown through the following generalized sequence of reactions:







The yields of  $\alpha,\beta$ -unsaturated aldehydes obtained were quite good and though incidental to the direct aim of this study, a good route to many otherwise difficultly accessible  $\alpha,\beta$ -unsaturated aldehydes has resulted from the reaction sequence.

The effect of several variables on the relative amounts of methyl and methylene condensation in the Claisen condensation of formate esters with 2-butanone and 2-pentanone was studied. In particular the effect on the position of condensation of the alkyl group of the formate ester and of the base used was studied, and hypotheses were developed to rationalize the observed results.

A satisfactory synthesis of *tert*-butyl formate was developed during the course of this work and an improved synthesis of 2-pentanone from acetoacetic ester was devised.

Reaction mechanisms to explain most of the reactions observed in the course of this work have been proposed and suggestions for future work in the field have been made.

Microfilm \$2.00; Xerox \$4.20. 77 pages.

#### SUBSTITUTED STYRENES, X REACTIONS OF THE HALOSTYRENES WITH THE DIOXANE SULFOTRIOXIDE COMPLEX

(L. C. Card No. Mic 58-5246)

Sammy Carpenter, Ph.D.  
University of Missouri, 1958

Supervisor: Wesley J. Dale

For the purpose of finding chemical evidence for the subtle electronic differences existing among the double bonds of the ring-halogenated styrenes, the following substituted styrenes have been prepared: *o*-, *m*- and *p*-fluorostyrene; *o*-, *m*- and *p*-chlorostyrene; *o*-, *m*- and *p*-bromostyrene; 2,4-difluorostyrene; *m*-trifluoromethylstyrene and 3-trifluoromethyl-4-fluorostyrene. Reasonably satisfactory methods were available in the literature for most of these styrenes, but the synthesis of 2,4-difluorostyrene had not been reported previously. A synthesis for this styrene was devised which began with the bromination of 2,4-difluorotoluene, which was followed by the hydrolysis of the 2,4-difluorobenzal bromide to form the corresponding aldehyde. After reaction of the aldehyde with methylmagnesium iodide, the resulting carbinol was dehydrated over alumina to give 2,4-difluorostyrene.

The above halostyrenes, and styrene itself, were allowed to react with various reagents to determine whether the varying electronegativities of the halogen substituents would be of sufficient strength to promote conjugate additions with sodio enolates or amines. However, attempts to

cause addition of these reagents to various halostyrenes were unsuccessful and only starting materials and tars were recovered. Furthermore, when competitive brominations of the olefinic bonds were investigated using, for example, styrene and *p*-fluorostyrene, no practical method was found for quantitatively separating the excess monomers from the dibromide mixtures.

The dioxane sulfotrioxide complex proved to be a useful reagent to distinguish between olefinic reactivity among the halostyrenes. For this purpose, styrene and the above ring-halogenated styrenes were caused to react with the dioxane sulfotrioxide complex and the identity and relative amounts of the water-soluble fractions were determined by gravimetric and volumetric analyses.

It was observed that when the fluorine atom is substituted in positions at increasing distances from the olefinic bond of styrene, the amount of sulfate-sulfonate product formed from the reaction of the monofluorostyrene with dioxane sulfotrioxide becomes less. Furthermore, the amount of sulfate-sulfonate obtained from the reaction of *meta* substituted styrenes with dioxane sulfotrioxide diminishes as the electronegativity of the *meta* substituent becomes less.

When logarithms of the per cent yields of the olefinic-sulfonate products formed from the reaction of *m*- and *p*-halostyrenes with dioxane sulfotrioxide complex were plotted against Hammett  $\sigma$  values for the corresponding substituents, it was evident that the yields could be correlated with the total electronic effect (inductive and resonance) of the substituents in the *meta* and *para* positions of these styrenes. The substituents therefore appear to affect the electron densities of the olefinic bonds in an orderly manner and these effects are manifested in the relative yields of olefinic-sulfonate obtained in the above reactions.

Microfilm \$2.00; Xerox \$6.60. 139 pages.

#### THE MAGNESIUM ENOLATE OF 2,2-DIPHENYLCYCLOHEXANONE

(L. C. Card No. Mic 58-5399)

James Paddock Collman, Ph.D.  
University of Illinois, 1958

The magnesium enolate of 2,2-diphenylcyclohexanone was prepared by the reaction of 2,2-diphenylcyclohexanone with the phenyl Grignard reagent, the action of magnesium on 6-bromo-2,2-diphenylcyclohexanone, and treatment of 6-bromo-2,2-diphenylcyclohexanone with the phenyl Grignard reagent.

The enolate was found to react with ethyl chloroformate and acetyl chloride to form 6-carbethoxy-2,2-diphenylcyclohexanone and 6-acetyl-2,2-diphenylcyclohexanone, respectively. Condensation of the enolate with ethyl acetate, acetone, *p*-chlorobenzaldehyde, and carbon dioxide proceeded in the 1,2-manner to produce 6-acetyl-2,2-diphenylcyclohexanone, 6-( $\alpha$ -hydroxyisopropyl)-2,2-diphenylcyclohexanone, 6-( $\alpha$ -hydroxy-*p*-chlorobenzyl)-2,2-diphenylcyclohexanone, and 3,3-diphenyl-2-ketocyclohexanecarboxylic acid, respectively. The enolate combined with chalcone in the 1,4-manner to form  $\beta$ -(3,3-diphenyl-2-ketocyclohexyl)- $\beta$ -phenylpropiophenone.

Under basic conditions 2,2-diphenylcyclohexanone



condensed with *p*-chlorobenzaldehyde and benzaldehyde to give 6-(*p*-chlorobenzylidene)-2,2-diphenylcyclohexanone and 6-benzylidene-2,2-diphenylcyclohexanone, respectively. The enolate added to 6-(*p*-chlorobenzylidene)-2,2-diphenylcyclohexanone in the 1,4-manner to form bis-(3,3-diphenyl-2-ketocyclohexyl)-*p*-chlorophenylmethane.

Treatment of 6-bromo-2,2-diphenylcyclohexanol with mercuric acetate or silver acetate produced 2,2-diphenylcyclohexanone. Microfilm \$2.00; Xerox \$5.00. 99 pages.

#### DERIVATIVES OF HEXACHLOROCYCLOPENTADIENE AND OCTACHLOROCYCLOPENTENE

(L. C. Card No. Mic 58-3147)

Ronald Dee Crain, Ph.D.  
Purdue University, 1958

Major Professor: E. T. McBee

##### I. Nucleophilic Displacement of Halogen by Methoxide Ion in Polychlorocyclopentenenes.

The preparations of the ketals of hexachloro-2-cyclopentenone, hexachloro-3-cyclopentenone, and tetrachloro-4-cyclopentene-1,3-dione are described. The initial attack of methoxide ion was proved to occur at the "1" carbon of the polychlorocyclopentenenes. The proposed mechanism for the nucleophilic substitution of halogen also applies to the reactions of 1,2-dichlorohexafluorocyclopentene with alcoholic base.

##### II. The Synthesis and Reactions of 1,2,3,5,5-Pentachlorocyclopentadiene.

The dehydrochlorination of 1,2,3,3,5,5-hexachlorocyclopentene with methanolic base, or the chlorination of 1,2,3,4-tetrachlorocyclopentadiene with a ferric chloride catalyst gives 1,2,3,5,5-pentachlorocyclopentadiene. The reactions of 1,2,3,5,5-pentachlorocyclopentadiene are discussed and compared with other polyhalocyclopentadienes.

##### III. Factors Involved in the Formation of Perhalopentacyclo[5,2,1,0<sup>2,6</sup>,0<sup>3,8</sup>,0<sup>5,8</sup>]decane and Related Compounds.

The aluminum bromide exchange reactions with hexachlorocyclopentadiene gives a mixture of 5-bromopentachlorocyclopentadiene and 5,5-dibromotetrachlorocyclopentadiene. Dimerization of hexachlorocyclopentadiene gives a mixture of brominated analogues of perchloropentacyclo[5,2,1,0<sup>2,6</sup>,0<sup>3,8</sup>,0<sup>5,8</sup>]decane. In order to elucidate the structures of these bromine compounds and the mechanism of their formation pure samples were prepared. Attempts to prepare halogenated "caged" compounds containing hydrogen led to the conclusion that whenever polychlorocyclopentadienes are used as the diene in the Diels-Alder synthesis the "exo" configuration results.

##### IV. The Chemistry of Dimethyl 1,4,5,6,7,7-Hexachlorobicyclo[2.2.1]hepta-2,5-diene-2,3-dicarboxylate.

The hydrolysis of dimethyl 1,4,5,6,7,7-hexachlorobicyclo[2.2.1]hepta-2,5-diene-2,3-dicarboxylate in basic solu-

tions or the reaction of hexachlorocyclopentadiene and acetylenedicarboxylic acid in dioxan gives a diacid analyzing for C<sub>12</sub>H<sub>6</sub>Cl<sub>6</sub>O<sub>4</sub> instead of the expected diacid, C<sub>6</sub>H<sub>2</sub>Cl<sub>6</sub>O<sub>4</sub>. Attempts to determine the identity of the formed diacid failed.

Microfilm \$2.05; Xerox \$7.20. 153 pages.

#### A STUDY OF THE COUPLING REACTIONS OF A VINYLOG OF N,N-DIETHYLANILINE AND RELATED ENAMINES

(L. C. Card No. Mic 58-5129)

James Walter Crary, Ph.D.  
Emory University, 1956

The reactions of N,N-diethylstyrylamine, a vinylog of N,N-diethylaniline, with aqueous aromatic diazonium salts have been investigated. On the basis of Fuson's principle of vinylogy the expected products were derivatives of azobenzene. However, the actual products were phenylglyoxal β-(phenylhydrazones), which have not been previously reported. With *p*-nitro-, *p*-chloro-, *p*-carboxy-, and *p*-methoxybenzenediazonium chloride, the corresponding *p*-substituted phenylhydrazones were obtained. Crystalline products could not be isolated from the reactions with diazotized aniline, sulfanilic acid, and *p*-aminophenol.

The reaction has been extended to 1-(1-butenyl)piperidine, an aliphatic enamine analogous to N,N-diethylstyrylamine, and the behavior was found to be identical. From diazotized *p*-nitroaniline, *p*-chloroaniline, and *p*-anisidine correspondingly substituted ethylglyoxal β-(phenylhydrazones) were isolated. The reaction with benzenediazonium chloride, however, appeared anomalous, and the identity of the crystalline compound melting at 134-5° remains uncertain.

Proof of structure of the substituted glyoxal β-(phenylhydrazones) was provided by the conversion into bis-(phenylhydrazones). The bis-(phenylhydrazones) were compared with those prepared by reactions known to lead to such compounds. Additional evidence for the structure of the glyoxal derivatives was obtained from a study of the infrared absorption spectra. The investigation was confined to the carbonyl, carbon to nitrogen double bond, and nitrogen to hydrogen bond wavelength regions. In the series of compounds studied the following assignments to the bands appearing in all the spectra were made:

C=O	5.88-5.95 microns
C=N	6.37-6.42 microns
N-H	2.95-3.00 microns

The reactions of enamines possessing no β-hydrogen atoms have been studied. The action of aromatic diazonium salts led to the formation of phenylhydrazones by the elimination of a formyl group. When treated with 2,4-dinitro-*p*-nitro-, and *p*-carboxybenzenediazonium salts 1-(β-methylstyryl)-piperidine gave the correspondingly substituted phenylhydrazones of acetophenone. From the reaction between 1-(1-isobutenyl)-piperidine and *p*-nitrobenzenediazonium chloride a solid was isolated which when treated with acid was converted into acetone *p*-nitrophenylhydrazone. From the same enamine and *p*-chlorobenzenediazonium



chloride an oil was obtained which under the influence of acid was transformed into a white crystalline compound which was probably acetone *p*-chlorophenylhydrazone. The nature of the acid labile intermediates was not investigated, but the possibility of their identity as mixed azo compounds is suggested.

When a solution of phenylglyoxal  $\beta$ -(*p*-methoxyphenylhydrazone) in ethanol containing a catalytic amount of sulfuric acid was heated at the reflux temperature for seven days, a white crystalline compound melting at 154° was isolated instead of the expected phenylglyoxal  $\alpha$ -(*p*-methoxyphenylhydrazone). An elemental analysis and molecular weight determination indicated that an intramolecular dehydration had occurred. On the basis of these data the compound was assigned the structure of 3-phenyl-6-methoxycinnoline, the result of a cyclodehydration of the aldehyde group into the aromatic nucleus. A rigorous proof of structure and a thorough investigation of the generality of the reaction is recommended, because of the potential value as a new method of synthesis of 3-substituted cinnolines.

Microfilm \$2.00; Xerox \$6.60. 137 pages.

# I. THE OPTICAL STABILITY OF 2,4-XYLIDINE DERIVATIVES HAVING 6-PHENYLMERCAPTO AND 6-BENZENESULFONYL SUBSTITUENTS.

## II. ATTEMPTED SYNTHESIS OF AN AZAQUINONEDIBENZENESULFONIMIDE: BENZENESULFONYL DERIVATIVES OF 2-AMINO-5-NITROPYRIDINE AND 2,5-DIAMINOPYRIDINE.

(L. C. Card No. Mic 58-5401)

Willis Eli Cupery, Ph.D.  
University of Illinois, 1958

### Part I

In order to study the effects of the phenylmercapto and benzenesulfonyl groups as ortho substituents in restricting rotation in aryl amines, four suitably substituted acids were prepared. N-Benzenesulfonyl-N-carboxymethyl-6-phenylmercapto-2,4-xylylidine and N-carboxymethyl-N,6-dibenzenesulfonyl-2,4-xylylidine were not resolved as their alkaloid salts could not be induced to crystallize. N-Methyl-N-succinyl-6-phenylmercapto-2,4-xylylidine and N-methyl-N-succinyl-6-benzenesulfonyl-2,4-xylylidine, resolved through their codeine salts, had optical half-lives of 0.40 and 8.6 hours, respectively, in dimethylformamide at 118°. These half-lives demonstrate the major importance of the bulk of ortho groups in restricting rotation, although an electron-withdrawing action by the phenylmercapto group was also noted.

The subject of electron-withdrawing resonance contributions of the sulfur atom was discussed. The work of Adams and Gibbs<sup>1</sup> was shown to imply a Hammett sigma of ca. 0.6 for the phenylmercapto group in the racemization of N-benzenesulfonyl-N-carboxymethyl-1-amino-2-methyl-6-phenylmercaptonaphthalene. Since sigma for this group in benzoic acid ionization is only 0.075,<sup>2</sup> it is apparent that a large resonance effect is found in racemizations about a para carbon to nitrogen bond.

N-Benzenesulfonyl-N-carbethoxymethyl-6-phenylmercapto-2,4-xylylidine and the corresponding 6-benzenesulfonyl

compound were best prepared by treatment with ethyl bromoacetate of a solution of the appropriate benzenesulfonamide in dimethylformamide. By usual procedures, only traces of product were obtained.

Infrared spectra of Nujol mulls of these acids, except N-methyl-N-succinyl-6-benzenesulfonyl-2,4-xylylidine, had relatively sharp O-H absorptions at 3300 cm.<sup>-1</sup> which must reflect steric hindrance of carboxyl association in the crystal.

### Part II

Since the additions which take place with benzoquinone-diacylimides would be very interesting in the pyridine series, 2,5-dibenzenesulfonamidopyridine and its 1-oxide were prepared and their oxidation to the corresponding azaquinonedibenzenesulfonimides attempted using a variety of conditions. These oxidations were unsuccessful.

In the course of this work, several new benzenesulfonyl derivatives of 2-amino-5-nitropyridine and 2,5-diaminopyridine were encountered. Benzenesulfonation of 2-amino-5-nitropyridine with benzenesulfonyl chloride in pyridine gave 2-dibenzenesulfonylamino-5-nitropyridine as a by product. Hydrogenation of this compound afforded 5-amino-2-dibenzenesulfonylamino-5-nitropyridine, which, upon benzenesulfonation, gave 5-benzenesulfonamido-2-dibenzenesulfonylamino-5-nitropyridine in high yield. 2-Benzenesulfonamido-5-dibenzenesulfonylamino-5-nitropyridine and 2,5-di-(dibenzenesulfonylamino)pyridine were by products of benzenesulfonation of N-2-(5-aminopyridyl)benzenesulfonamide.

In pyridine, an equilibrium exists with the benzenesulfonyl derivatives: thus, N-2-(5-nitropyridyl)benzenesulfonamide was converted with excess *p*-toluenesulfonyl chloride to mono- and di-*p*-toluenesulfonyl derivatives of 2-amino-5-nitropyridine. The infrared spectra of the above compounds were quite similar in the 1600 cm.<sup>-1</sup> region, and differed from that of the reaction product of methyl iodide with 2-dibenzenesulfonylamino-5-nitropyridine, which absorbed strongly at 1645 cm.<sup>-1</sup> and was suggested to be 1-methyl-5-nitro-2-pyridonebenzenesulfonimide. On these bases, the 1-benzenesulfonyl-2-pyridonebenzenesulfonimide structures for the polybenzenesulfonyl derivatives, above, were eliminated.

Microfilm \$2.00; Xerox \$7.00. 150 pages.

1. R. Adams and H. H. Gibbs, *J. Am. Chem. Soc.*, **79**, 170 (1957).
2. H. H. Szmant and G. Suld, *ibid.*, **78**, 3400 (1956).

## THE STRUCTURE OF STREPTOLIDINE

(L. C. Card No. Mic 59-494)

Edward George Daniels, Ph.D.  
University of Illinois, 1958

Previous studies had shown that the acid hydrolysis of the antibiotic, streptothricin, gave four principal degradation products --  $\beta$ -lysine, an amino acid which was named streptolidine, an aminosugar, and a fragment (Compound C) composed of streptolidine and the aminosugar (1, 2, 3).

The 2-amino-2-deoxy- $\alpha$ -D-gulose, isolated from the acid hydrolysates of Compound C, was identified as 2-amino-2-deoxy- $\alpha$ -D-gulose by comparison with an identical aminosugar isolated from streptolisin B (4).



The barium hydroxide hydrolysis of 4,5-dicarboxyl-2-iminoimidazolidine yielded diaminosuccinic acid as the principal product with the evolution of one mole of ammonia.

4-Hydroxymethyl-5-carboxyl-2-iminoimidazolidine (I) was synthesized by means of a series of reactions starting with meso-diaminosuccinic acid. Several other substituted derivatives of 2-iminoimidazolidine were also prepared.

The barium hydroxide hydrolysis of I and the reduced one mole periodate oxidation product of streptolidine (II) each gave one mole of ammonia and a compound identified by paper chromatography as 2,3-diamino-4-hydroxybutyric acid.

Catalytic reduction of the methyl ester of II with a Raney nickel catalyst gave a diol which consumed only 0.18 mole of periodate per mole of compound with the formation of 0.17 mole of formaldehyde.

The propyl ester of streptolidine was reduced catalytically to give a mixture of compounds. Periodate oxidation of the ninhydrin- and Weber-positive product resulted in the uptake of slightly over one mole of periodate.

The tentative structure of 4-( $\alpha$ -hydroxy- $\beta$ -amino)-ethyl-5-carboxyl-2-iminoimidazolidine is proposed for streptolidine.

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2. West, C. A., Thesis, Doctor of Philosophy, University of Illinois, 1952.
3. Pierce, Jack V., Thesis, Doctor of Philosophy, University of Illinois, 1956.
4. van Tamelen, E. E., Dyer, J. R., Carter, H. E., Pierce, J. V., Daniels, E. G., *J. Am. Chem. Soc.*, **78**, 4817 (1956). Microfilm \$2.25; Xerox \$7.80. 170 pages.

#### TETRAPHENYLACETONE - A STUDY OF ITS DERIVATIVES

(L. C. Card No. Mic 58-5131)

Douglas Orr Dean, Ph.D.  
Emory University, 1950

The reaction of sodium upon ethyl diphenylacetate has been quantitatively studied and a mechanism for the formation of tetraphenylacetone and diphenylmethane from this reaction is offered. A study of the scope of this interesting cleavage was undertaken, utilizing diphenylacetyl chloride, N,N-diethyl diphenylacetamide, methyl triphenylacetate, ethyl cyanophenylacetate and ethyl, fluorene 9-carboxylate.

Tetraphenylacetone was reduced smoothly to the secondary alcohol, tetraphenylisopropyl alcohol, by lithium aluminum hydride.

The bromination of tetraphenylacetone in the presence of water yielded tetraphenylallene dioxide as the predominant reaction product when the bromination is carried out over a long period of time.

Additional evidence is cited to prove the identity of the diepoxide tetraphenylallene dioxide. The diepoxide was

reduced by the use of red phosphorous, iodine and acetic acid to a mixture of tetraphenylpropylene and tetraphenylpropane. The diepoxide when treated with methylmagnesium iodide gave no evidence of an active hydrogen and an addition product was isolated, m. p. 228°.

Tetraphenylallene dioxide was shown to be an extremely stable diepoxide, being inactive towards hydrochloric acid and acetic anhydride. It was reduced by lithium aluminum hydride to a derivative of melting point 246°.

Tetraphenylallene was oxidized mildly with chromic acid to yield the same diepoxide as referred to above. The reduction of tetraphenylallene was carried out, yielding tetraphenylpropylene.

Bromotetraphenylacetone was permitted to react with triethylamine, yielding a small amount of material, m. p. 132°, which gave no depression of melting point when mixed with tetraphenylacetone. In addition to this product, there was isolated a resinous material of inconsistent melting point. It was found that the reaction of the bromoketone with triethylamine is much faster than the reaction of the bromoketone with pyridine.

Bromotetraphenylacetone was permitted to react with pyridine and tetraphenylallene dioxide was isolated in ten per cent yield. A large amount of resinous material was also obtained from the reaction. A qualitative study of the rate of reaction of pyridine with bromotetraphenylacetone was made and it was found that the use of solvents such as toluene and a lowering of the concentration of pyridine, greatly diminished the rate of reaction.

Active hydrogen determinations were carried out on the following compounds: Ethyl diphenylacetate, diphenylacetyl chloride, N,N-diethyl diphenylacetamide, ethyl fluorene 9-carboxylate, tetraphenylacetone, bromotetraphenylacetone, methoxytetraphenylacetone and tetraphenylallene dioxide.

Microfilm \$2.00; Xerox \$4.20. 80 pages.

#### THE SYNTHESIS OF PHYSIOLOGICALLY ACTIVE COMPOUNDS

(L. C. Card No. Mic 58-5138)

John Julian Duncan, Ph.D.  
Emory University, 1958

Tuberculosis, pathogenic fungi and cancer are three diseases which have resisted treatment by the medical doctor. In the quest for compounds which are active against the agents which cause these illnesses, much valuable information has been gained. Two classes of compounds which have shown some effectiveness against tubercule bacilli and pathogenic fungi are long-chain aliphatic amines and certain carboxylic acids. In the hope that these features, when combined in one molecule, might produce a powerful therapeutic agent, a series of N-alkyl-chelidamic acids were prepared. Certain  $\beta,\beta$ -dialkylglutarimides are pyrimidine antagonists, and may, therefore, have activity against carcinogenic agents. It was discovered that  $\beta$ -methyl- $\beta$ -ethylglutarimide had, at the same time, the ability to counteract the effect of phenobarbital and pentobarbital. It was therefore of interest to prepare a series of  $\beta,\beta$ -dialkylglutarimides and  $\beta$ -ethyl- $\beta$ -phenylglutarimide, the glutarimide most similar in gross



structure to phenobarbital, for testing as barbiturate antagonists and as anticancer agents.

N-(n-butyl)-, N-(n-amyl)-, N-(n-heptyl)-, N-(n-decyl)-, N-(n-dodecyl)-, N-(n-tridecyl)-, N-(carboxymethyl)-, N-2-(4-morpholine)-ethyl-, and N-benzyl-chelidamic acids were prepared by the condensation of the appropriate amines with the disodium salt of chelidonic acid in a water or water-ethyl cellosolve medium.  $\beta,\beta$ -Dimethyl-,  $\beta,\beta$ -diethyl-,  $\beta$ -methyl- $\beta$ -ethyl-,  $\beta$ -methyl- $\beta$ -n-propyl-,  $\beta$ -methyl- $\beta$ -n-butyl-,  $\beta,\beta$ -tetramethylene,  $\beta$ -methyl- $\beta$ -n-amyl-, and  $\beta$ - $\beta$ -methyl- $\beta$ -n-hexyl-glutarimides were prepared by the condensation of the appropriate ketones with two moles of ethyl cyanoacetate and one mole of ammonia, hydrolysis of the resulting  $\alpha,\gamma$ -dicyano- $\beta,\beta$ -dialkyl-glutarimides to the corresponding glutaric acids, and pyrolysis of the ammonium salts of the acids to the glutarimides.

A new method of synthesis was devised for  $\beta$ -alkyl- $\beta$ -arylglutarimides and employed in the preparation of  $\beta$ -ethyl- $\beta$ -phenyl-glutarimide. In the specific case,  $\alpha$ -phenyl-butyronitrile was condensed with ethyl bromoacetate, and the product was hydrolyzed to yield 2-ethyl-2-phenylsuccinic acid. The anhydride of this acid was prepared and converted into the half-ester of 2-ethyl-2-phenylsuccinic acid by selective opening of the anhydride with absolute methanol. This reaction left the more hindered acid group unesterified, allowing homologation of this acid to the glutaric acid. The half-ester was converted into the acid chloride and then into the diazoketone which rearranged in the presence of aqueous silver nitrate and aqueous ammonia to yield the desired  $\beta$ -ethyl- $\beta$ -phenylglutarimide.

Microfilm \$2.00; Xerox \$3.00. 53 pages.

#### THE PREPARATION AND REACTIONS OF SOME CYCLOHEXADIENONES

(L. C. Card No. Mic 58-5415)

Robert Rowntree Fraser, Ph.D.  
University of Illinois, 1958

The reaction of the lithium salt of 2,6-dimethylphenol with methyl iodide provides 20% of 2,6,6-trimethyl-2,4-cyclohexadienone. The sodium, aluminum and bromomagnesium salts give less of this product and more of the O-alkylated product, 2,6-dimethylanisole. The reaction has been found to be catalysed by Lewis acids, the best and most practical one being excess 2,6-dimethylphenol. Methyl p-toluenesulfonate and methyl p-bromobenzenesulfonate give very little C-alkylation, the product being almost entirely 2,6-dimethylanisole. The solvent for this reaction is methyl iodide.

2,6,6-Trimethyl-2,4-cyclohexadienone forms on standing a solid dimer whose structure has been rigorously established from spectral and dipole moment data to be endo-1,4,6,6,9,9-hexamethyl- $\Delta^{3,11}$ -tricyclo[2.2.2.4<sup>2,7</sup>]-dodecane-5,10-dione. The dimer can be used as a source of dienone since it equilibrates with the dienone on heating.

The dienone, when heated with butadiene, gives two Diels-Alder adducts, one from its reaction as a dienophile, 1,3,3-trimethyl- $\Delta^{3,6}$ -decahydronaphthalene-2-one, the other from its reaction as a diene, 1,3,3-trimethyl- $\Delta^{5,7}$  or 8-vinylbicyclo[2.2.2]octane-2-one. The cyclopentadiene adduct, 1,8,8-trimethyl- $\Delta^{4,10}$  or  $\Delta^{3,10}$ -tricyclo[2.2.2.3<sup>2,6</sup>]-

undecane-9-one, results from the reaction of cyclopentadiene with dienone at room temperature. The reaction of dienone with vinyl acetate gives product which has been shown by a series of degradations and conversions to be a mixture of two adducts, 1,3,3-trimethyl- $\Delta^{5,7}$ -acetoxybicyclo[2.2.2]octane-2-one and 1,3,3-trimethyl- $\Delta^{5,8}$ -acetoxybicyclo[2.2.2]octane-2-one.

Microfilm \$2.00; Xerox \$7.20. 151 pages.

#### THE CONDENSATION OF ABIETIC ACID WITH FORMALDEHYDE

(L. C. Card No. Mic 58-5145)

Joseph Lee Greene, Jr., Ph.D.  
Emory University, 1958

Highly purified abietic acid and formaldehyde were caused to condense under the conditions of the Prins Reaction employing several types of acid catalysis to give at least one crystalline condensation product. Mineral acids such as sulfuric acid in inert solvents such as p-dioxane were found to be the most efficient condensation catalysts, but at the same time these conditions caused such extensive polymerizations of the abietic acid that they were useless for obtaining identifiable condensation products.

When glacial acetic acid was utilized both as the acid catalyst and as the solvent, an identifiable condensation product was isolated in poor yields. Substitution of acetic acid by propionic acid materially increased the yield of product which was tentatively identified as 8,9-bis-methylenepropionyabietic acid. This material was isolated from the reaction mixture as its cyclohexyl amine salt, and was purified by recrystallization of the salt before regeneration of 8,9-bis-methylenepropionyabietic acid by mild acidification. The ester, upon basic hydrolysis and subsequent acidification, gave 8,9-dimethylolabietic acid. Elemental analyses, neutral equivalent determination, infra red and ultra violet absorption spectra substantiated the structure, 8,9-dimethylolabietic acid. This dimethylol compound was converted via catalytic dehydrogenation to a phenanthrene derivative believed to be 1,8,10-trimethyl-2-isopropylphenanthrene.

In order to establish the structure of the condensation product beyond reasonable doubt 1,8,10-trimethyl-2-isopropylphenanthrene was synthesized in an unambiguous manner as follows:  $\alpha$ -bromo-o-xylene was condensed with diethyl methylmalonate. Basic hydrolysis and subsequent decarboxylation under acidic conditions gave  $\alpha$ -methyl- $\beta$ -(o-tolyl)propionic acid which was homologated via the Arndt-Eistert reaction to  $\beta$ -methyl- $\gamma$ -(o-tolyl)butyric acid. A Friedel-Crafts ring closure produced 3,5-dimethyl-1-tetralone which was condensed with ethyl bromoacetate to give 1-methylenecarbethoxy-3,5-dimethyl-1,2,3,4-tetrahydronaphthalene. Catalytic dehydrogenation then gave ethyl (3,5-dimethylnaphthyl-1)acetate which was reduced with lithium aluminum hydride to give 1-hydroxy-2-(3,5-dimethylnaphthyl-1)ethane. This latter substance was converted to the corresponding bromide and subsequently condensed with diethyl isopropylmalonate to give a substituted malonic ester which upon hydrolysis and decarboxylation gave 2-isopropyl-4-(3,5-dimethylnaphthyl-1)-butyric acid. Friedel-Crafts ring closure of this substance



produced 8,10-dimethyl-2-isopropyl-1-keto-1,2,3,4-tetrahydrophenanthrene. Condensation of this ketone with methyl magnesium iodide, hydrolysis, dehydration and dehydrogenation produced 1,8,10-trimethyl-2-isopropylphenanthrene. This hydrocarbon so synthesized was shown to be identical to that obtained from the formaldehyde-abietic acid condensation product.

Thus it was conclusively shown that the condensation of formaldehyde with abietic acid in acetic acid or in propionic acid led to 8,9-bis-methyleneacetoxyabietic acid and to 8,9-bis-methylenepropionoxyabietic acid respectively. Microfilm \$2.00; Xerox \$5.00. 96 pages.

I. THE STEREOSPECIFIC SYNTHESIS OF CHOLESTEROL-7 $\alpha$ -t AND CHOLESTEROL-7 $\beta$ -t.  
THE STEREOCHEMISTRY OF 7 $\alpha$ -HYDROXYLATION IN THE BIOSYNTHESIS OF CHOLIC ACID FROM CHOLESTEROL.  
II. THE STEREOCHEMISTRY OF 11 $\alpha$ -HYDROXYLATION OF STEROIDS.  
III. AN INVESTIGATION OF TRANSFER OF ELECTROPHILIC HYDROGEN TO CARBON DURING REDUCTION OF ALKYL HALIDES BY METAL AND HYDROGEN DONOR.

(L. C. Card No. Mic 58-5422)

George Anastasiou Gregoriou, Ph.D.  
University of Illinois, 1958

I. Cholesterol-7 $\alpha$ -t (and 7 $\alpha$ -d) and cholesterol-7 $\beta$ -t (and 7 $\alpha$ -d) with isotopic labelling stereospecific to the extent of 97  $\pm$  3% were synthesized by a novel method.

The tritiated cholesterol were used to investigate the stereochemical course of the 7 $\alpha$ -hydroxylation involved in the biochemical conversion of cholesterol to cholic acid in rats. The results obtained indicated that this 7 $\alpha$ -hydroxylation proceeds by displacement of the 7 $\alpha$ -hydrogen (or tritium) substituent with at least 93% and possibly complete specificity, i.e., with overall retention of configuration.

II. Pregnane-3,20-dione-11 $\beta$ -d and pregnane-3,20-dione-9 $\alpha$ , 11 $\alpha$ , 12 $\alpha$ -d<sub>3</sub> were synthesized.

The deuterated pregnanediones were used to investigate the stereochemical course of their microbiological 11 $\alpha$ -hydroxylation by *Rhizopus nigricans*. The results obtained indicated that this hydroxylation proceeds by stereospecific displacement of the 11 $\alpha$ -hydrogen (or deuterium) substituent, i.e., with overall retention of configuration.

III. Several aspects of the reaction  $RHal + Metal + HA \rightarrow RH + Hal^-$  were investigated. Studies were conducted on the stereochemical course (using deuterium tracer) of the reduction of various 3 $\alpha$ - and 3 $\beta$ -halocholestanes by means of several reducing systems (zinc-acetic acid, calcium-ammonia, lithium ethylenediamine, hydrogen-palladium, mercury cathode).

The rate of reduction by zinc-acetic acid in ether was measured on bromides of the 3-cholestane, the cyclohexane, and the open chain series. The effect of a number of variables (concentration of halide and acid, hydrogen isotope, competitive adsorption of halides, etc.) on the rate of reduction of 3 $\alpha$ -bromocholestane was studied.

Microfilm \$2.40; Xerox \$8.40. 183 pages.

THE SYNTHESIS AND STRUCTURE OF SOME FLUORINE-CONTAINING SILICON COMPOUNDS

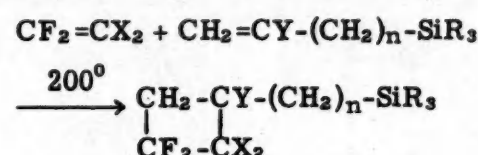
(L. C. Card No. Mic 59-828)

James D. Groves, Ph.D.  
University of Colorado, 1958

Supervisors: Professors Joseph D. Park and John R. Lacher

The thermal and chemical stability of silicone polymers and tetraalkylsilanes and the inherent stability of the carbon-fluorine and the carbon-carbon bonds in polyfluoroolefins have led to attempts to incorporate the attributes of both systems into a single moiety of high stability. Thus, the unified aim of this investigation was the extension of the basic knowledge concerning the synthesis and chemistry of fluorine-containing silicon compounds. The approach to this overall aim was directed toward investigating and extending the inhibited cyclization reactions of alkenylsilanes and fluoroolefins. The reactions which have been carried out in this work are summarized below.

The general reaction utilized in the preparation of twelve members of this class of fluorine-containing silanes was as follows:



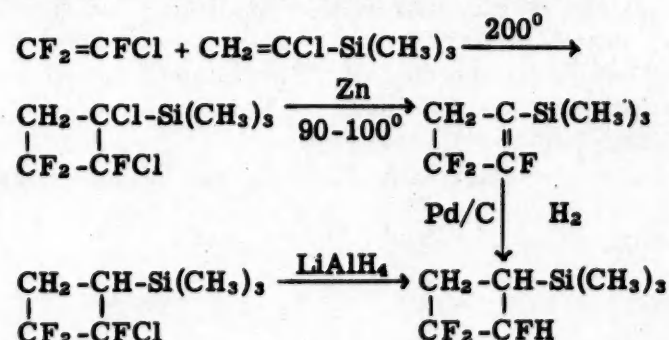
where:

X = F and/or Cl      n = 0 to 3

Y = -Cl or H      R = OC<sub>2</sub>H<sub>5</sub>, CH<sub>3</sub> and/or Cl.

The silanes  $\overline{CF_2-CF_2-CH_2-CH-(CH_2)_3Si(CH_3)_3}$  and  $\overline{CF_2-CF_2-CH_2-CH-CH_2-Si(CH_3)_3}$  were submitted to the Air Force for low temperature viscosity and thermal stability evaluation. Similarly, the silicone monomer,  $\overline{CF_2-CF_2-CH_2-CH-Si(CH_3)_2Cl}$  was forwarded to the same organization for polymerization studies. The silane,  $\overline{CF_2-CF_2-CH_2-CH-Si(CH_3)_3}$  was inert to dilute acid and 20% potassium hydroxide solution, unlike  $\alpha$ -fluorine-containing silanes.

The structure of  $\overline{CFCl-CF_2-CH_2-CH-Si(CH_3)_3}$  was established by the following sequence of reactions:



It is postulated that the chlorine atoms in  $\overline{CFCl-CF_2-CH_2-CCl-Si(CH_3)_3}$  are cis to one another.

Conjugated systems such as 1,3-butadiene, acrylonitrile, phenylacetylene and styrene codimerize with



$\text{CF}_2=\text{CX}_2$ -type fluoroolefins easier and in better yields than do olefins with isolated unsubstituted terminal double bonds. These conjugated systems presumably attain resonance stabilized transition states. Recent evidence indicates that the silicon atom is capable of expanding its valence shell to accommodate ten electrons. Thus, in the vinylsilanes one can visualize (at least in the transition state) contributions from electronic forms such as,  $(\text{CH}_3)_3\text{Si}-$

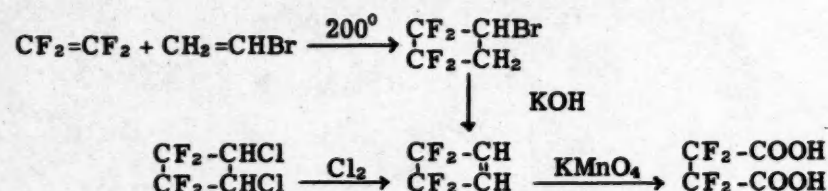
$\begin{matrix} (-) & (+) & & (-) & (+) \\ \text{Si}-\text{CH}-\text{CHR} & - & (\text{CH}_3)_3\text{Si}=\text{CH}-\text{CHR} \end{matrix}$  Further evidence to support this recent theory regarding the conjugative ability of silicon is presented in this work.

When the codimer of  $\text{CF}_2=\text{CFCl}$  and vinyltrichlorosilane was treated with methylmagnesium bromide, a trimethylsilylcyclobutane was obtained which was identical to the one prepared from the codimerization of  $\text{CF}_2=\text{CFCl}$  and vinyltrimethylsilane.

A brief investigation of free radical additions to vinyltrimethyl- and vinyltrichlorosilane resulted in the preparation of  $\text{CF}_2=\text{CF}-\text{CH}_2-\text{CHI}-\text{Si}(\text{CH}_3)_3$  and  $\text{CF}_2=\text{CFCH}_2-\text{CHI}-\text{SiCl}_3$ .

In a miscellaneous section a number of studies are discussed and are summarized below.

The reported cyclic dimerization of  $\text{CF}_2=\text{CHCl}$  was disproven by the unequivocal synthesis of 3,4-dichloro-1,1,2,2-tetrafluorocyclobutane by the following scheme:



A brief investigation was undertaken to expand the reactions of fluorovinyl iodides and fluoroallyl alcohols. An unsuccessful attempt was made to prepare  $\text{CF}_2=\text{CFCH}_2\text{OH}$ , utilizing the Grignard reagent of  $\text{CF}_2=\text{CFI}$ . The Grignard reagent of  $\text{CF}_2=\text{CClI}$  was readily obtained by an exchange reaction with phenylmagnesium bromide. When  $\text{CF}_2=\text{CClCH}_2\text{OH}$  was treated with phosphorous tribromide,  $\text{CF}_2=\text{CClCH}_2\text{Br}$  was isolated in an almost quantitative yield. This allyl bromide failed to form a Grignard reagent under the usual reaction conditions. No products were isolated in the attempted free radical addition of  $\text{CF}_2=\text{CClI}$  and  $\text{CF}_2=\text{CFI}$  to alkynes.

A rather extensive investigation of the Lewis acid-catalyzed addition of acid chlorides to fluoroolefins was undertaken in an attempt to prepare fluorine-containing  $\alpha,\beta$ -unsaturated ketones. Most of these reactions resulted in the temporary isolation of fuming, lachrymatory liquids, which on standing darkened and finally polymerized.

The physical properties of all new compounds prepared in this work were determined and their infrared spectrograms recorded and discussed.

Microfilm \$2.00; Xerox \$5.00. 97 pages.

## SYNTHETIC AND SPECTRAL STUDIES OF MONO- AND DIHYDROXYFLAVONES THEIR DERIVATIVES.

PART I: SYNTHETIC STUDIES.

PART II: SPECTRAL STUDIES.

(L. C. Card No. Mic 58-3768)

Walter William Hanneman, Ph.D.  
University of Nebraska, 1958

Adviser: James Howard Looker

An integrated series of seventy compounds, composed of  $\gamma$ -pyrones, chromones, mono-, and dihydroxyflavones have been synthesized by various known procedures. A comparative study of the available synthetic routes has been made.

A general synthetic route to 5-hydroxy-3-arylflavones has been explored. The deuteration of 5-hydroxyflavone has been studied.

Solid state infrared spectra in potassium bromide pellets have been determined for all compounds over the range 4000-650  $\text{cm}^{-1}$ . Using carbon tetrachloride or dioxan as a solvent, the carbonyl stretching frequency has been determined for each member of this series.

The relationship of structure to infrared spectra has been discussed with regards to the aromatic rings, heterocyclic oxygen atom, pyrone carbonyl, hydroxy groups, methoxyl groups, acetoxyl groups, and 3-aryl substituents.

Microfilm \$3.10; Xerox \$10.60. 238 pages.

## SOME THEORETICAL ASPECTS OF ORGANIC SILICON CHEMISTRY

(L. C. Card No. Mic 58-3165)

Richard Allan Hickner, Ph.D.  
Purdue University, 1958

Major Professor: Dr. Robert A. Benkeser

**Part I. The Acid Cleavage of Some Meta-Substituted Phenyltrimethylsilanes.** - The rates of cleavage of some 3-alkylphenyl- and (3,5-dialkylphenyl)trimethylsilanes were determined. The rates for the monoalkyl derivatives increased in the same order as the inductive effects, i.e.,  $\text{H} < \text{Me} < \text{Et} < i\text{-Pr} < t\text{-Bu}$ . The rates of cleavage of the dialkyl derivatives agreed well with those calculated from the partial relative rates for the monoalkyl series. The absence of steric effects in the meta-position and the additivity of electrical effects on the rate of cleavage was demonstrated.

**Part II. The Meerwein Reaction with Vinylsilanes.** - Diazonium salts containing electron withdrawing groups were added to vinylsilanes in fair yield. The adducts could be dehydrohalogenated only under vigorous conditions. This reaction provides further evidence for the expansion of the silicon octet. A number of unsuccessful Michael additions are also reported.

**Part III. The Stereochemistry of the Addition of Trichlorosilane to Acetylenes.** - Trichlorosilane was added to phenylacetylene and three aliphatic acetylenes in the presence of benzoyl peroxide or platinized charcoal.



Peroxide was found to give a stereospecific trans addition to produce cis adducts. Platinized charcoal resulted in a stereospecific cis addition producing trans adducts.

Microfilm \$2.25; Xerox \$7.80. 170 pages.

#### SOME STUDIES IN THE AUTOXIDATION OF d-LIMONENE

(L. C. Card No. Mic 58-5150)

Samuel Emmett Horne, Jr., Ph.D.  
Emory University, 1950

d-Limonene is the main constituent of the various citrus oils. These oils are widely used as food flavoring agents. During storage periods the flavor and odor of these oils undergo a change. In this work a series of reactions were carried out in which d-limonene was subjected to the action of molecular oxygen to see if the changes were due to an autoxidative change of d-limonene.

It was found that the autoxidation of d-limonene is best carried out at room temperature under the influence of ultra-violet light. The reaction can be followed conveniently by the gain in weight of the d-limonene. Autoxidation at room temperature leads to a better grade of product as shown by a visual inspection of the color and viscosity. Elevated temperature autoxidation of d-limonene results in a very viscous and dark colored reaction mixture.

d-Limonene hydroperoxide is thought to be the initial product of the autoxidation of d-limonene. The best method for the decomposition of this hydroperoxide is a basic hydrolysis of the hydroperoxide group with sodium hydroxide. A thermal decomposition of the hydroperoxide leads to general polymerization.

The autoxidation of d-limonene leads to a very complex mixture of products. The identified products of the autoxidation are carvone, carveol, 1,2-epoxy d-limonene, 1,2-dihydroxy d-limonene, and polymers of d-limonene. The autoxidation of d-limonene is a more complex process than would be indicated by the literature.

The autoxidation of d-limonene is very susceptible to environment. Reagents normally thought to produce free radicals increase the rate of autoxidation of d-limonene, while those reagents which may combine with free radicals have an inhibiting effect on the rate of autoxidation. The rate of autoxidation of d-limonene is increased by d-limonene hydroperoxide, *t*-butyl hydroperoxide, metallic stearates, citral, and benzaldehyde. The rate of autoxidation is inhibited by hydroquinone, water, acids, *t*-butyl benzene, di-*t*-butyl peroxide, and sodium carbonate. The rate of autoxidation was measured by the rate of absorption of oxygen from a gas burette.

d-Limonene is resistant to hydroxylation under conditions that normally convert an olefin to a glycol. A compound was isolated in each hydroxylation reaction but it was not the expected dihydroxy d-limonene, perhaps the product is the tetrahydroxy compound.

d-Limonene reacts readily with monoperphthalic acid to give 1,2-epoxy d-limonene in good yield. The literature reports the use of perbenzoic acid for the preparation of the epoxide but does not report the use of monoperphthalic acid; the latter acid is much easier to prepare and gives

higher yields of the epoxide than those reported for perbenzoic acid.

1,2-Epoxy d-limonene is readily cleaved by acids to give 1,2-dihydroxy d-limonene in good yield. This glycol is an interesting compound and may provide a route to carveol by dehydration of the tertiary hydroxyl group.

An excellent procedure has been worked out for the preparation of d-limonene nitrosochloride on a large scale. An old procedure was described in the literature for small scale preparations, but it was not applicable to large scale ones. The new method involves the use of either gaseous methyl or ethyl nitrite and moist hydrogen chloride at low temperature. Moist conditions are necessary, for anhydrous conditions result in very low yields. This compound is an important intermediate in the transformation of d-limonene into carvone.

d-Limonene nitrosochloride may be converted readily into carvoxime by an elimination of hydrogen chloride. The dehydrohalogenation is best effected by pyridine and results in good yields of the oxime. Carvoxime may be hydrolyzed to carvone by 5 per cent oxalic acid. All reaction steps go in good yields and give an over all yield of 61 per cent from d-limonene to carvone.

The mode of hydrolysis of carvoxime determined the product. A hydrolysis effected by 5 per cent oxalic acid results in carvone; a hydrolysis by 5 per cent hydrochloric acid yields carvacrol. Either product is obtained exclusively under the proper conditions. This method also furnishes an excellent method for the preparation of carvacrol.

The autoxidation of citral has been found to yield geranic acid as the only identified product. Some evidence has been obtained for the existence of an  $\alpha$ -keto acid as a product but no positive identification was made.

Published data on the possible transformation of d-limonene were of little practical value in the prosecution of this work. Microfilm \$2.00; Xerox \$5.20. 105 pages.

#### THE ADDITIVE NATURE OF STRUCTURAL UNITS IN THE PARACHORS OF DITERTIARY GLYCOLS AND CHLORIDES

(L. C. Card No. Mic 58-5152)

Thomas Patrick Johnston, Ph.D.  
Emory University, 1948

The parachor, first considered an additive property, has been shown to be highly susceptible to minor differences in structure, as, for example, those existing between two isomeric alcohols. This would at first seem to decrease its usefulness. If such differences are capable of evaluation, however, the parachor immediately becomes a more delicate tool for correlating physical properties with structure. Results have been obtained with series of tertiary alcohols and chlorides permitting the publication of tables from which reliable values for such types may be calculated.

Minor structural effects are commonly omitted in calculating parachor values, showing considerable deviation from observed values. If whole structural groups can in fact be evaluated, they should in turn be primarily additive in more complex structures. To test this a number of



compounds of the types,  $R-C-(CH_2)_n-C-R$  and  $R-C-(CH_2)_n-R$  where  $R = OH$  or  $Cl$ , were synthesized by standard methods. The theoretical

cal value for half of each molecule was calculated from the tables and doubled to give the theoretical parachor of the larger molecule. For eleven ditertiary chlorides and five ditertiary glycols the average deviations between calculated and observed values were respectively, 0.7 and 1.1 percent. Values calculated with disregard for these "minor" structural differences give average deviations of 2.3 and 3.4 percent for the respective dichlorides and glycols. Closer agreement was noted when the functional groups were separated by four or more carbon atoms.

An extensive historical review of the parachor with emphasis on the development of its dual additive and constitutive nature is given. The evolution of the maximum bubble pressure method of measuring surface tension into a convenient and accurate method has been followed. A supplement bringing up to date a complete list of literature references has been included.

Microfilm \$2.00; Xerox \$6.20. 127 pages.

#### A STUDY OF THE STRUCTURE OF A 7,8-DIHYDROABIETIC ACID

(L. C. Card No. Mic 58-5153)

Robert Wilson Kennedy, Ph.D.  
Emory University, 1957

The results of the research are summarized in the following statements:

(1) Pure abietic acid was obtained from a commercial grade of abietic acid through purification of its diamylamine salt. A method was found for the chemical reduction of abietic acid or its diamylamine salt, using metallic lithium in liquid ammonia, to obtain an homogeneous dihydroabietic acid-I.

(2) An isomeric dihydroabietic acid-II was obtained by the acid isomerization of dihydroabietic acid-I, using anhydrous hydrogen bromide in glacial acetic acid. The homogeneity of each of the dihydroabietic acids was proved.

(3) The position of the double bond in dihydroabietic acid-I was proved via ozonolysis with cyclic anhydride formation of the resulting ketodicarboxylic acid. The existence of the anhydride was proved by infrared analysis, saponification equivalent and molecular weight determination. The position of the double bond in dihydroabietic acid-II was not rigorously proved, but was reasonably indicated by its reaction with nitrosylchloride and subsequent reactions of its blue nitrosochloride. Further indication of its structure was indicated by ozonolysis of the unsaturated acid.

(4) A new  $\delta$ -lactone was discovered which was derived from either of the isomeric dihydroabietic acids above. A well known  $\gamma$ -lactone was simultaneously formed with the  $\delta$ -lactone and isolated as its corresponding  $\gamma$ -hydroxytetrahydroabietic acid.

(5) A discussion of the structures of the two dihydroabietic acids and the  $\gamma$ - and  $\delta$ -lactones is given which includes a proposed mechanism for the formation of the mixture of lactones and their probable stereochemistry.

(6) A crystalline diamylamine salt of the ketodicarboxylic acid from the ozonolysis of dihydroabietic acid-I was obtained. Physical properties of this salt and its infrared spectrum are included.

(7) The most successful methods for the ozonolysis of resin acids and the subsequent oxidative decompositions of the ozonides are discussed. The experimental procedures of the most successful methods are included.

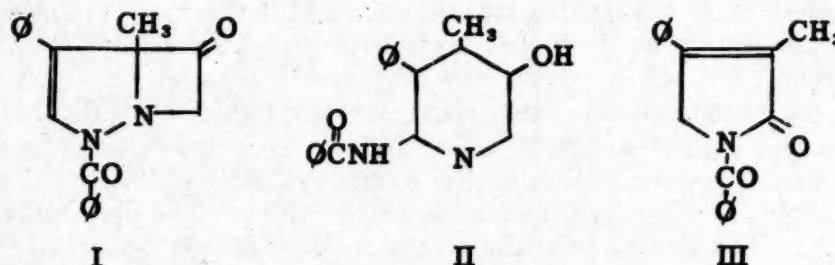
(8) The most pertinent infrared spectra and all quantitative analyses are included in the Appendix of the dissertation. Microfilm \$2.00; Xerox \$4.80. 95 pages.

#### THE REACTIONS OF 2-BENZOYL-5-METHYL-4-PHENYL-1,2-DIAZABICYCLO[3.2.0]HEPT-3-EN-6-ONE AND RELATED TOPICS

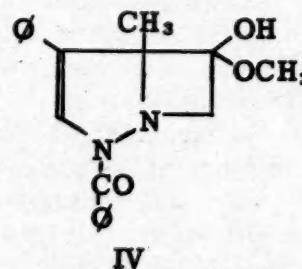
(L. C. Card No. Mic 58-5292)

Frank J. Marascia, Ph.D.  
University of Delaware, 1958

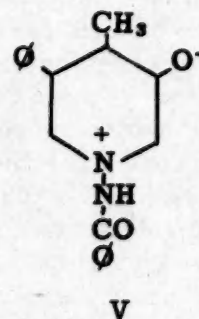
Several of the products obtained from the various rearrangements and reactions of 2-benzoyl-5-methyl-4-phenyl-2,2 diazabicyclo[3.2.0]hept-3-en-6-one (I) have been identified. The rearrangement of (I) in methanol furnished



2-benzamido-5-hydroxy-4-methyl-3-phenylpyridine (II), 3-methyl-4-phenyl  $\Delta^3$ -pyrroline-2-one (III) and ammonia.

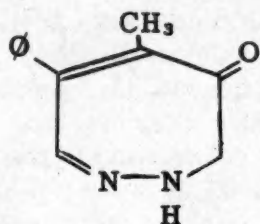


A hemi-ketal (IV) was formed when (I) was refluxed in methanol containing trace amounts of benzoic acid. When a methanolic solution of (I) was treated with concentrated



hydrochloric acid, the product isolated was 1-benzamido-3-hydroxy-4-methyl-5-phenylpyridinium hydroxide, inner salt (V). The diazepine (VI) was regenerated when (I) or (IV) was warmed with glacial acetic acid.

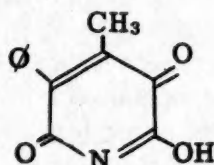




VI

An attempt has been made to correlate these reactions in terms of a common diazairane intermediate.

The pyridine section is concerned with the synthesis of and reactions of 2-amino-5-hydroxypyridine and its 4-methyl-3-phenyl derivative. This study led to the preparation of a new azaquinone (VII).



VII

Microfilm \$2.00; Xerox \$6.40. 133 pages.

#### SYNTHESIS OF 2,2,4-TRIPHENYL-3-OXETANONE AND BASE-CATALYZED OXIDATION OF 1,1,3-TRIPHENYLACETONE

(L. C. Card No. Mic 58-5165)

Jane Lewis Maxwell, Ph.D.  
Emory University, 1957

The structure of the class of compounds known as oxetanones was recently elucidated by Hoey's work on 2,2,4,4-tetraphenyloxetanone. He found the ring structure to be remarkably resistant to cleavage by acid, but cleavage by base to give O-benzhydrylbenzilic acid was possible. The only carbonyl reaction which the hindered ketone would undergo was the addition of, or reduction by, a Grignard reagent. The infrared spectrum of the compound was in accord with the reported spectra of oxetanes and  $\beta$ -propiolactone. The latter compound has a carbonyl band which is shifted to higher wave numbers indicating a "strained carbonyl" structure which is also typical of the oxetanone.

Hoey prepared the oxetanone by several methods including the photobromination of tetraphenylacetone in wet carbon tetrachloride and the bromination of hydroxytetraphenylacetone in dry carbon tetrachloride.

In general the autoxidation of ketones has produced the expected carboxyl and carbonyl oxidative-cleavage products, whether the reaction was carried out with acidic or basic catalysts or by irradiation with no catalyst at all. In the cases of other ketones the procedure which was followed with the triphenylacetone was known to give some products due to rearrangement without cleavage. Hoey found one of the products of the base-catalyzed autoxidation of triphenylacetone to be mandelic acid benzhydryl ether, an acid similar to the acid obtained by the base cleavage of the tetraphenyloxetanone.

This dissertation is concerned with the preparation of

triphenyloxetanone and with a further study of the base-catalyzed autoxidation of triphenylacetone. Parker had previously shown that the preferred method of preparation of the tetraphenyloxetanone--forced-air oxidation of the tetraphenylacetone in acetic acid--would not give the triphenyloxetanone. The oxetanone has now been prepared by the bromination of 1,1,3-triphenyl-1-hydroxy-2-propanone and the dehydrobromination of the bromohydroxyketone.

1,1,3-Triphenyl-1-hydroxy-3-bromo-2-propanone was prepared in 87% yield by the reaction of bromine with the hydroxyketone in dry carbon tetrachloride under irradiation of an ultraviolet lamp which also raised the temperature to approximately 40°. Dehydrobromination of the bromohydroxyketone was accomplished by the reaction of silver nitrate in dry t-butyl alcohol for several days at about 40°. The isolated products from this reaction were benzoic acid and benzophenone. The presence of the oxetanone was confirmed by the characteristic infrared absorption spectrum for the cyclic ketone, and by the reaction of the oily material with potassium hydroxide in alcohol, to produce the expected cleavage product, mandelic acid benzhydryl ether, in 67% yield. The oxetanone would not distill or crystallize, however.

Further studies of the base-catalyzed oxidation of triphenylacetone were made using one and two equivalents of the alkoxide ion. The products of the equimolar alkoxide-ion oxidation were benzoic acid (19%), benzophenone (19%), benzyldeoxybenzoin (9%), a trace of the ether-acid, and a compound which melted at 212° and had an elemental analysis corresponding to a formula of  $C_{22}H_{20}O_3$ , but which was not further identified. No reasonable mechanism for the formation of the benzyldeoxybenzoin could be proposed, except that it was obviously formed by rearrangement of the original ketone without reaction with the oxygen. An infrared spectrum of reaction mixture, before separation of the ketones, did not show any band for the oxetanone.

The products of the oxidation using two equivalents of the alkoxide ion were benzoic acid (21%), benzophenone (31%), mandelic acid benzhydryl ether (25%), and the compound which melted at 212°. A probable mechanism for the formation of the ether-acid through the formation of the oxetanone is given.

Microfilm \$2.00; Xerox \$3.80. 68 pages.

#### NEW POLYCYCLIC SYSTEMS CONTAINING NITROGEN AT A BRIDGEHEAD POSITION

(L. C. Card No. Mic 59-999)

Kenneth Bruce Moser, Ph.D.  
Duke University, 1959

Supervisor: Charles K. Bradsher

This dissertation is divided into four sections. Section One contains a literature review of the methods of synthesis for partially hydrogenated derivatives of the benzo[a]-quinolizinium ion. A table of all the partially hydrogenated compounds that have been prepared through December, 1956, is included in this section.

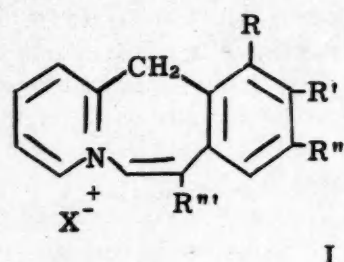
Section Two describes the extension of the general method of Bradsher and Beavers<sup>1</sup> to the synthesis of some



benzo[a]quinolizinium compounds with substituents in the terminal rings. It was found that a sufficiently large substituent in the 2' position of the intermediate aryl acetonpyridinium salt caused reduction in yield of the cyclized product. A group at this position impedes the achievement of coplanarity of the two rings, which seems to be a prerequisite for cyclization.

Section Three describes the use of an acid-catalyzed aromatic cyclodehydration reaction for the preparation of the entirely new dibenzo[a,h]- and tribenzo[a,c,h]quinolizinium ions. In these syntheses, it was found that a methoxyl group para to the point of cyclization was necessary to overcome a steric inhibition similar to that described in Section Two.

Section Four is concerned with the synthesis and proof of structure of some substituted morphanthridizinium salts (I).



A typical preparation involves quarternization of 2-benzylpyridine with iodoacetone, followed by an acid-catalyzed ring closure to give I ( $R'' = \text{CH}_3$ ). A methoxyl group at  $R'$  was found to activate the point of cyclization and greatly reduce the reaction time necessary for ring closure. The preparation of four of these salts is described.

On the basis of our experience, the acid-catalyzed aromatic cyclodehydration reaction appears to be quite general and offers a route to aromatic bridgehead nitrogen compounds not easily synthesized by other means.

Microfilm \$2.00; Xerox \$4.80. 93 pages.

1. C. K. Bradsher and L. E. Beavers, *J. Am. Chem. Soc.*, **77**, 453 (1955).

#### PREPARATIONS AND RELATIVE REACTIVITIES OF THE COMMON RING BROMOMETHYLCYCLOALKANES

(L. C. Card No. Mic 58-5168)

Arthur Homer Neal, Ph.D.  
Emory University, 1954

The object of this study was to determine the relative effects of the common rings on displacement reactions at an adjacent saturated carbon center. No previous studies have been reported from which the relative effects of these important ring systems may be derived, and the indirect evidence found in the literature is inconsistent.

For these studies the bromomethylcycloalkanes were chosen as typical derivatives to subject to the displacement reactions under kinetic conditions. The most frequently used method for the preparation of these compounds is treatment of the corresponding cycloalkylcarbinols with hydrogen bromide or phosphorus tribromide. The litera-

ture indicates that this method is unreliable, however, due to the possibilities for isomerization, leading to mixtures of isomers. For this reason, the compounds were prepared from the cycloalkylcarbinols and phosphorus tribromide and also by decarboxylation of the silver cycloalkylacetates with bromine. The latter procedure was found to yield the pure bromomethylcycloalkanes in yields of 38 to 58 per cent.

Comparison of the infrared spectra of the products from the alternative preparations showed that the treatment of cyclopentylcarbinol with phosphorus tribromide gave a mixture of about 20 per cent of cyclohexylbromide and 80 per cent of bromomethylcyclopentane under the conditions used. Similar preparations with the cyclohexyl and cycloheptyl derivatives showed no evidence of ring enlargement, and the products had infrared spectra essentially identical with the products from the decarboxylation procedure.

The authentic bromomethylcycloalkanes were allowed to react with sodium thiophenoxide in absolute ethanol under kinetic conditions. Isobutyl bromide was also studied as the simplest acyclic analogue of the ring compounds. The reactions showed very satisfactory second-order kinetics and were conveniently followed by determining the unreacted thiophenoxide ion by acid-base titrations. The rate constants were determined at four temperatures and the data were used to calculate the energies of activation and other thermodynamic quantities.

To demonstrate that the reactions followed kinetically were simple displacement reactions, the bromides were treated with sodium thiophenoxide on a preparative scale under conditions similar to those of the kinetic studies. The corresponding alkyl phenyl sulfides were isolated in yields of 84 to 93 per cent. The actual yields were larger than this. The sulfides derived from the bromomethylcycloalkanes are new compounds.

The kinetic studies showed the following order of reactivities for the bromides: bromomethylcycloheptane > bromomethylcyclohexane > isobutyl bromide > bromomethylcyclopentane. The rates varied only about three-fold, however, from the fastest to the slowest reaction at a given temperature.

Due to the small differences in rates within the series and the similar temperature coefficients of the reactions, the thermodynamic constants obtained generally differed by less than the uncertainties inherent in these quantities. Except for the fact that the cycloheptyl compound definitely showed the smallest energy of activation, no other analysis of the thermodynamic data, in terms of energy and entropy effects, seemed justified.

The relative rates are considered to give the best indication of the comparative steric effects of the common rings. Examination of scale models of the bromide molecules indicates a parallel between reactivity and ring flexibility in the common ring series. The more flexible ring systems can attain configurations such that the bromomethyl group may rotate about the bond joining it to the ring. This allows the displacing reagent to approach the rear side of the central carbon atom with less hindrance.

Microfilm \$2.00; Xerox \$5.60. 101 pages.



# THE ADDITION OF HYDROGEN BROMIDE TO DINITRILES AND THE IDENTIFICATION OF LAGIDZE'S HYDROCARBON

(L. C. Card No. Mic 59-1286)

James H. Osborn, Ph.D.  
University of Minnesota, 1958

The addition of hydrogen bromide to dinitriles has been found to give intermediate bis-iminobromides, which in systems sterically favorable for ring formation, cyclize to give nitrogen heterocyclic compounds. This cyclization occurs by displacement of the bromine atom of one iminobromide function by the electron pair of the nitrogen atom of the other to give the hydrobromide of a heterocyclic

system of the generalized structure,

$$\begin{array}{c} | \quad | \\ \text{Br}-\text{C}=\text{N}-\text{C}=\text{NH} \\ | \quad | \\ \cdot \text{HBr} \end{array}$$

When the cyclization is not sterically favorable, the reaction of the bis-iminobromide occurs preferentially with the solvent (ether) to give the bis-iminoether hydrobromide.

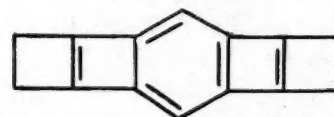
The addition of hydrogen bromide to *o*-benzenediacetonitrile gave a stable crystalline product (I). This material, which was a hydrobromide salt, was converted to the free nitrogen base whose structure was established as 2-imino-6-bromo-4,5-dihydro-3,1H-benzazepine (II) on the basis of its conversion to *o*-phenylenediacetamide. The tautomeric alternatives for I and II were eliminated on the bases of their infrared spectra. The reaction of hydrogen bromide with succinonitrile, meso- $\alpha,\alpha'$ -diphenylsuccinonitrile, and *o*-phthalonitrile was also found to give cyclic products, whose structures were established by their conversion to the corresponding cyclic imides. The preferred tautomeric alternatives of the addition products were selected on the bases of their infrared spectra.

The reaction of hydrogen bromide with malononitrile gave a product which still contained the nitrile function. This product, which contained associated hydrogen bromide, was converted to a  $\text{C}_6\text{H}_5\text{N}_4\text{Br}$  compound upon mild treatment with base. Two alternative structures were considered for this bimolecular product: 1) the compound containing a pyridine ring, 3(5)-cyano-6-bromo-2,4-diaminopyridine formed by carbon to carbon condensation of malononitrile and subsequent cyclization of this intermediate (1), and 2) the compound containing a pyrimidine ring, 2-( $\alpha$ -cyano-methyl)-4-amino-6-bromo-pyrimidine formed by intermolecular cyclization of the malononitrile-hydrogen bromide addition intermediate. The chemical evidence obtained from the reactions of this  $\text{C}_6\text{H}_5\text{N}_4\text{Br}$  compound was consistent with either formulation for this product, while infrared spectral evidence could be cited in support of specific structures in each of the alternative reaction sequences. The interpretation of the nuclear magnetic resonance data, however, was consistent only with the pyridine structure for this  $\text{C}_6\text{H}_5\text{N}_4\text{Br}$  compound.

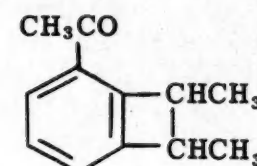
In the case of adiponitrile, no cyclization resulted upon reaction with hydrogen bromide, but rather the bis-iminoether hydrobromide of adiponitrile was formed. Similarly the intermediate iminobromide formed by the addition of hydrogen bromide to acetonitrile reacted with the solvent to form the iminoether hydrobromide in preference to an intermolecular condensation.

# THE IDENTIFICATION OF LAGIDZE'S HYDROCARBON

The reaction of benzene with 2-butyne-1,4-diol diacetate in the presence of equivalent amounts of aluminum chloride was reported by Lagidze and Petrov to give a hydrocarbon, m.p.  $103^\circ$ , and a ketone, b.p.  $119-121^\circ$  (2 mm.) (2). On the basis of carbon-hydrogen and x-ray diffraction analysis, the structure III was assigned for this hydrocarbon. The results of the x-ray analysis which was reported indicated that the molecule was centrosymmetric, and a molecular weight of  $188 \pm 10$  was calculated from the cell dimensions and an approximate density determination. Since the ketone gave hemimellitic acid upon oxidation, it was assigned the structure IV on the basis of its expected similarity to the hydrocarbon.



III



IV

The results of the present study have shown that the hydrocarbon is 2-phenylnaphthalene and that the ketone is 5,6,7,8-tetrahydro-2-acetonaphthone. Acetophenone was also identified from the products of this reaction. In addition, a liquid hydrocarbon, b.p.  $145-172^\circ$  (5 mm.), was isolated. That this hydrocarbon is 1,2,3,4-tetrahydro-2-phenylnaphthalene is suggested from a consideration of a probable mechanism for the course of the alkylation reaction.

## REFERENCES

1. R. A. Carboni, D. D. Coffman, and E. G. Howard, J. Am. Chem. Soc., 80, 2838 (1958).
2. R. M. Lagidze and A. D. Petrov, Doklady Akad. Nauk. S.S.S.R., 83, 235 (1952). Chem. Abstr., 47, 4321g (1953). Microfilm \$2.00; Xerox \$6.40. 132 pages.

## I. AN EXTENDED INVESTIGATION OF THE CHLORINATION OF *n*-PROPOXY-1,1,2-TRIFLUORO, 2-CHLOROETHANE.

## II. PHOTOCHEMICAL DIMERIZATION OF $\text{CF}_2=\text{CHBr}$ AND STUDY OF THE REACTIONS OF THE DIMER.

(L. C. Card No. Mic 59-834)

George Pavlow, Ph.D.  
University of Colorado, 1958

Supervisors: Professors Joseph D. Park and John R. Lacher

The investigation of the chlorination of *n*-propoxy-1,1,2-trifluoro,2-chloroethane is an extension of the study of the directed chlorination of fluorinated alkyl ethers initiated by this laboratory.

In this work it was possible to synthesize unequivocally



the  $\beta$  and  $\gamma$  monochloro derivatives of *n*-propoxy-1,1,2-trifluoro-2-chloroethane. The structure of the  $\alpha$  chlorosubstituted isomer was arrived at by a process of elimination since only three monochloro isomers of the ether are possible. Synthesis of the dichlorinated isomers of the same ether was carried out with the following products isolated:  $\alpha,\beta$ -dichloroether,  $\beta,\gamma$ -dichloroether,  $\beta,\beta$ -dichloroether,  $\alpha,\gamma$ -dichloroether and  $\gamma,\gamma$ -dichloroether. Two trichloro ether derivatives were prepared and the structure of  $\text{CH}_2\text{Cl}-\text{CHCl}-\text{CHCl}-\text{O}-\text{CF}_2-\text{CFCI}_2\text{H}$  was definitely determined. The proof of structure of the dichloro isomers was deduced on the basis of dehydrohalogenation, chlorination and ozonolysis reactions. The physical properties and the infrared spectra of:  $\text{CH}_3-\text{CH}_2-\text{CHCl}-\text{O}-\text{CF}_2-\text{CFCI}_2\text{H}$ ,  $\text{CH}_3-\text{CHCl}-\text{CH}_2-\text{O}-\text{CF}_2-\text{CFCI}_2\text{H}$ ,  $\text{CH}_2\text{Cl}-\text{CH}_2-\text{CH}_2-\text{O}-\text{CF}_2-\text{CFCI}_2\text{H}$ ,  $\text{CH}_3-\text{CH}=\text{CCl}-\text{O}-\text{CF}_2-\text{CFCI}_2\text{H}$ ,  $\text{CH}_2\text{Cl}-\text{CH}_2-\text{CHCl}-\text{O}-\text{CF}_2-\text{CFCI}_2\text{H}$ ,  $\text{CH}_2=\text{CH}-\text{CHCl}-\text{O}-\text{CF}_2-\text{CFCI}_2\text{H}$ ,  $\text{CH}_2\text{Cl}-\text{CH}=\text{CH}-\text{O}-\text{CF}_2-\text{CFCI}_2\text{H}$ ,  $\text{CH}_3-\text{CH}(\text{OH})-\text{CH}_2-\text{O}-\text{CF}_2-\text{CFCI}_2\text{H}$ ,  $\text{CH}_3-\text{CH}(\text{COOC}_2\text{H}_5)-\text{CH}_2-\text{O}-\text{CF}_2-\text{CFCI}_2\text{H}$  and  $\text{CH}_3-\text{CCl}_2-\text{CH}_2-\text{CH}_2-\text{O}-\text{CF}_2-\text{CFCI}_2\text{H}$  were obtained.

The photochemical dimerization of the 1,1-difluoro-2-bromoethylene was carried out in a flow system. The method and the apparatus used in the dimerization of  $\text{CF}_2=\text{CHBr}$  are discussed. The dimer was isolated and assigned the structure  $\text{CF}_2=\text{CH}-\text{CHBr}-\text{CF}_2\text{Br}$  (I) on the basis of the reaction with zinc where the diene,  $\text{CF}_2=\text{CH}-\text{CH}=\text{CF}_2$  was isolated. The structure proof of the diene was confirmed by the vapor density measurement and by the comparison of the infrared spectrogram with the known compound. The presence of the other possible adduct,  $\text{CF}_2=\text{CH}-\text{CF}_2-\text{CHBr}_2$  (II) was also confirmed. These isomers I and II were found to be present in the ratio of about 1:4. The mechanism of the addition which is contrary to some of the similar free radical reactions is discussed. The infrared spectrograms of the dimer, which shows an absorption in the region of 5.6 microns is in accord with the known fluorinated olefins. Various reactions of the dimer involving chlorination, ozonolysis and hydrolysis with fuming sulfuric acid were carried out. The study and analysis of the trimer was not carried out although the product was isolated. The number of possible isomers of the trimer make the analysis of the same rather complex. The physical properties and the infrared spectra of the  $\text{CF}_2=\text{CHBr}$  dimer, the  $\text{CF}_2=\text{CHBr}$  trimer,  $\text{CF}_2\text{Cl}-\text{CHCl}-\text{CHBr}-\text{CF}_2\text{Br}$ ,  $\text{CFCI}-\text{CHCl}-\text{CHBr}-\text{CHO}$ ,  $\text{CHO}-\text{CH}=\text{CF}_2$  and  $\text{COOH}-\text{CBr}=\text{CF}_2$  were obtained.

Microfilm \$2.00; Xerox \$5.40. 110 pages.

#### OXIDATION OF CONJUGATED DIENES; THE PREPARATION OF 1,4-EPIDIOXY- 2-CYCLOHEXENE AND ITS REACTIONS

(L. C. Card No. Mic 59-1289)

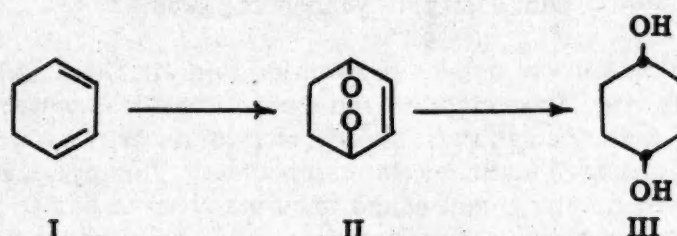
Wesley Andrew Pearson, Ph.D.  
University of Minnesota, 1958

The structure of ascaridole, a naturally occurring peroxide was established by Wallach (1) and others (2,3) as 1,4-epidioxy-2-*p*-menthene. Its thermal rearrangement in inert solvents and its reaction with hydrazine have been investigated (4).

The present work was concerned with the preparation

of a structurally similar compound, 1,4-epidioxy-2-cyclohexene (II) and with a study of its chemistry.

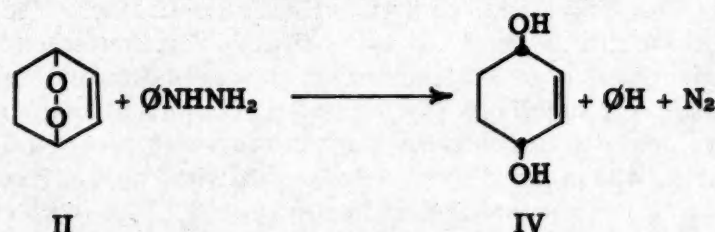
1,4-Epidioxy-2-cyclohexene (II) was prepared by the light catalyzed addition of oxygen to 1,3-cyclohexadiene (I). Its structure was established by catalytic hydrogenation to the known compound, *cis*-1,4-cyclohexanediol (III).



A preliminary study of the thermal stability of 1,4-epidioxy-2-cyclohexene in inert solvents indicated that a rearrangement took place but that the product was not the expected 1,2-3,4-diepoxy-cyclohexane.

The reaction of 1,4-epidioxy-2-cyclohexene with various hydrazines was investigated. Hydrazine reacted with 1,4-epidioxy-2-cyclohexene in an ethanol solution to yield a nitrogen-containing compound of unknown structure. Methylhydrazine and *sym*-dimethylhydrazine were shown to give similar results.

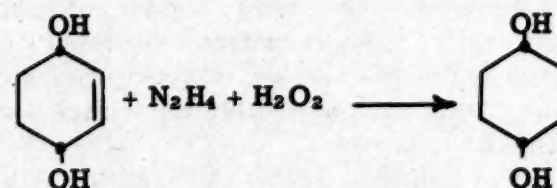
The product from the reaction of phenylhydrazine with 1,4-epidioxy-2-cyclohexene was shown to be *cis*-2-cyclohexene-1,4-diol (IV). Hydrazobenzene gave the unsaturated diol (IV) and azobenzene as the products.



The preparation of *cis*-2-cyclohexene-1,4-diol (IV) in good yields from the reaction of 1,4-epidioxy-2-cyclohexene and hydrazine in the presence of added insoluble materials was discovered. The same product resulted from the reaction of methylhydrazine or *sym*-dimethylhydrazine and 1,4-epidioxy-2-cyclohexene in the presence of solids.

Ascaridole has been shown to react with hydrazine or phenylhydrazine to yield *cis*-*p*-menthane-1,4-diol (4). The reaction of ascaridole with hydrazine or phenylhydrazine in the presence of added insoluble materials was investigated giving *cis*-2-*p*-menthene-1,4-diol in good yields.

The reduction of carbon-carbon double bonds and certain carbonyl groups by a hydrazine-hydrogen peroxide mixture was investigated. *cis*-2-Cyclohexene-1,4-diol (IV) was reduced in good yields by this mixture to *cis*-1,4-cyclohexanediol (III).



The reduction of cyclohexene, *trans*-stilbene, cinnamic acid and benzophenone by a hydrazine-hydrogen peroxide mixture was discovered.

Microfilm \$2.00; Xerox \$5.40. 109 pages.



THE PRODUCTS OF THE REACTION BETWEEN  
OXYGEN AND TRIMETHYLBORANE BELOW  
THE EXPLOSION LIMITS

(L. C. Card No. Mic 59-412)

Robert Charles Petry, Ph.D.  
The Ohio State University, 1958

Trimethylborane ignites spontaneously in air, and its mixtures with oxygen are explosive at room temperature at pressures above 15-20 mm. Below the explosion limit an equimolar trimethylborane - oxygen oxidation product is formed. In view of the exact stoichiometry of the non-explosive reaction and the speed with which it occurred, it was of interest to investigate the nature of the product. The oxidation product was prepared in a flow system at room temperature. The reaction was found to be quantitative with molar flow ratios of oxygen to trimethylborane of approximately 2:1, with a 2- to 3-minute contact time and a reactor pressure of 10-15 mm. The exclusive product of the reaction was identified as dimethylborylmethylperoxide,  $(\text{CH}_3)_2\text{BOOCH}_3$ , which represents the first example of an organo-boron peroxide to be isolated and characterized. The peroxide is explosive; it liberates iodine quantitatively from a degassed sodium iodide - isopropanol - acetic acid solution. Reduction with anhydrous hydrogen iodide at  $-82^\circ\text{C}$ . leads to the formation of methoxydimethylborane water and iodine. The extrapolated boiling point of the peroxide is  $44^\circ\text{C}$ . A 1:1 adduct is formed by reaction with pyridine. The peroxide is comparatively stable at  $-82^\circ\text{C}$ . but is unstable in the liquid and gas phase at room temperature, rearranging in high yield to dimethoxymethylborane,  $(\text{CH}_3\text{O})_2\text{BCH}_3$ . The liquid phase rearrangement and decomposition has a half-life of less than one day at room temperature; minor decomposition products include methane, ethane and trimethylboroxine. In addition to the major product, dimethoxymethylborane, which accounts for over 50 per cent of the overall decomposition in the temperature range  $25^\circ$  to  $47.8^\circ\text{C}$ ., the gas phase decomposition products of the peroxide include hydrogen, carbon monoxide, methane, ethane, methyl formate, dimethoxymethane, methoxydimethylborane, trimethyl borate and a residue of low volatility. The kinetics of the gas phase decomposition were found to be complex and non-reproducible in Pyrex reaction vessels. The reaction has an appreciable heterogeneous component; evidence for the participation of methyl radicals in the decomposition was obtained by experiments in the presence of propylene, but the major portion of the decomposition apparently does not occur by a radical chain mechanism. The peroxide rearranges to dimethoxymethylborane in benzene and chloroform solution; partial decomposition was indicated by the formation of methane. The solution kinetics in absence of air are consistent with a first order law.

Microfilm \$3.55; Xerox \$12.00. 274 pages.

PART I: SOME REACTIONS OF  
ETHYL DIAZOACETATE.  
PART II: THE SELENIUM DEHYDROGENATION  
OF  $\alpha$ -AMYRIN BENZOATE.

(L. C. Card No. Mic 59-692)

Robert Joseph Pfeiffer, Ph.D.  
Cornell University, 1958

Part I. Some Reactions of Ethyl Diazoacetate.--The reaction of ethyl diazoacetate with allylic double bonds has been investigated and shown to yield rearranged olefins whose structure could not be explained on the basis of the well-established reactions of diazoacetic ester. In order to gain support for the  $\text{S}_{\text{N}}2'$ -type of mechanism proposed for these anomalous reactions and to determine the scope among substituted allylic compounds, attempts were made to synthesize a number of suitably constituted olefins.

The routes to the desired allylic halides that were investigated included allylic chlorination, addition of alkyl halides to conjugated dienes, the dehydration of chlorinated alcohols and the replacement of hydroxyl by chloride.

The reaction of 3-chlorocyclohexene with ethyl diazoacetate resulted in the formation of ethyl  $\alpha$ -chloro- $\alpha$ -( $\Delta^2$ -cyclohexenyl)acetate, a product that is consistent with an  $\text{S}_{\text{N}}2'$ -type of reaction mechanism. A moderate amount of a similarly rearranged olefin was also formed in the reaction of ethyl diazoacetate with allyl acetate, although the evidence for its structure was not as conclusive as for the 3-chlorocyclohexene product.

The use of tri-n-butyl borate or tri-n-dodecyl borate as catalysts for the reactions of diazoacetic ester with allylic compounds resulted in the same type of rearranged products that were obtained with copper catalysis. The fact that neither copper nor the borate esters was capable of promoting the reaction between ethyl diazoacetate and 1,1,3-trifluoro-3,3-dichloropropene, a particularly reactive electrophile, indicated that the intermediates formed by the two catalysts were not nucleophilic in the normal sense. The observation that the borate esters did not catalyze the decomposition of ethyl diazoacetate even at  $50^\circ$ , whereas the addition of small amounts of copper at this temperature caused immediate decomposition to diethyl fumarate would further indicate that the intermediates formed by the two catalysts are probably different.

Since the borate ester catalysts afforded the same products as those derived from the copper-catalyzed reactions, homogeneous catalysis of these reactions is possible and kinetic studies now become more feasible.

Part II. The Selenium Dehydrogenation of  $\alpha$ -Amyrin Benzoate.--The dehydrogenation of  $\alpha$ -amyrin benzoate with selenium powder was carried out at  $10^\circ$  intervals from  $340$ - $380^\circ$ . The non-volatile products were separated by chromatographic analysis and partially identified by their absorption spectra, analyses, reactions and derivatives.

It was found that the lowest temperature reaction resulted in the formation of an unconjugated  $\alpha$ -amyradiene contaminated with 5-10% of a homoannular diene.

The  $350^\circ$  reaction produced an impure  $\alpha$ -amyradiene as well as four pentacyclic products, two of which contained naphthalene chromophores and two of which contained phenanthrene chromophores. In addition, the expected 2,9-dimethylpicene was obtained.

At  $360^\circ$ , the dehydrogenation resulted in the formation



of most of the products isolated from the 350° reaction, but with increased yields of the more highly aromatized products.

The reaction carried out at 370° produced 2-methylchrysene and 2,9-dimethylpicene.

The reaction at 380° produced only 2-methylchrysene.

The formation of pentacyclic products containing naphthalene and phenanthrene chromophores had not previously been observed to result from the dehydrogenation of triterpenes.

The isolation of the unexpected 2-methylchrysene emphasizes the caution that must be observed in interpreting dehydrogenation results.

Possible structures of the products isolated that are consisted with the experimental data are presented.

Microfilm \$2.00; Xerox \$6.40. 133 pages.

#### MIGRATORY APTITUDES OF THE CYCLOPROPYL GROUP IN THE SCHMIDT REACTION OF TERTIARY ALCOHOLS AND KETONES

(L. C. Card No. Mic 59-302)

George H. Potter, Ph.D.

Rensselaer Polytechnic Institute, 1958

Supervisor: Stanley C. Bunce

A series of tertiary azides containing two cyclopropyl groups were rearranged. The products obtained were a mixture of amines, a cyclopropyl ketone and oxetone. Taking cyclopropyl migration as unity the following migratory aptitudes were obtained: *m*-chlorophenyl - 20.7, *n*-butyl - 23.4, *p*-chlorophenyl - 29, phenyl - 62, *m*-tolyl - 103, *p*-tolyl - 141, *o*-anisyl - 200, and *p*-anisyl - 300.

The Schmidt reaction was conducted on phenyl and *p*-tolyl cyclopropyl ketones. The migratory aptitudes obtained, taking cyclopropyl migration as unity, were 19.9 and 66 respectively.

The migratory aptitudes obtained in the rearrangements studied are explained on the basis of electronic interactions. It is also concluded that the loss of water to form the iminodiazonium ion does not occur in the Schmidt reaction on ketones.

The amount of cyclopropylamine produced in the rearrangements was determined by isotopic dilution studies using carbon-14 labeled cyclopropylamine. The activity of the carbon-14 samples was determined by dry combustion and proportional-counting of the resulting carbon dioxide as carbon dioxide. To do this radioactive analysis, a vacuum system and combustion train with all accessories were built and calibrated. The electronic equipment for proportional-counting was built by modifying existing equipment.

Besides carbon-14 labeled cyclopropylamine, ring-labeled dicyclopropyl ketone and cyclopropanecarboxylic acid were prepared.

A series of diarylcyclopropylcarbinols and a series of arylidicyclopropylcarbinols were prepared and characterized. The tertiary azides used in this investigation were prepared from the arylidicyclopropyl carbinols.

Microfilm \$2.05; Xerox \$7.20. 154 pages.

#### STUDIES ON THE PREPARATIONS AND ACYLATIONS OF *PARA*-*TERT*-BUTYLTOLUENE

(L. C. Card No. Mic 58-5171)

Rajnandan Prasad, Ph.D.

Emory University, 1954

Four methods have been tried for the synthesis of *p*-*tert*-butyltoluene. Friedel-Crafts method of synthesis using toluene, *tert*-butylchloride and anhydrous ferric chloride gave a mixture of *m*- and *p*-*tert*-butyltoluenes. Condensation of the Grignard reagent from *p*-bromo-*tert*-butylbenzene with dimethyl sulphate gave an unidentified mixture including a low yield of *p*-*p'*-di-*tert*-butyldiphenyl. Grignard reagent from *p*-bromotoluene on reaction with *tert*-butyl chloride gave a thirty-two per cent yield of *p*-*tert*-butyltoluene (contaminated with *p*-cresol); 2.3 per cent of *p*-cresol and nine per cent of *p*-*p'*-ditolyl were obtained as by-products. Pure *p*-*tert*-butyltoluene was obtained in sixty-four per cent yield when isobutyl alcohol was allowed to react with toluene in the presence of excess of fuming sulphuric acid.

Chloromethylation of *tert*-butylbenzene gave about seventy per cent of *p*-*tert*-butylbenzyl chloride. The Grignard reagent from this chloromethyl compound on addition to acetic anhydride produced pure 2-methyl-5-*tert*-butylacetophenone (in nineteen per cent yield), an unidentified ketone, b.p. 97°/2.2 mm., semicarbazone m.p. 144°-145°, and *p*-*p'*-di-*tert*-butyldiphenyl (m.p. 128-129°).

*p*-*tert*-Butyltoluene has been brominated to give seventy-three per cent of *o*-bromo-*p*-*tert*-butyltoluene. The Grignard reagent from *o*-bromo-*p*-*tert*-butyltoluene on adding to acetic anhydride at -35° to -50° gave a fifty-three per cent yield of 2-methyl-5-*tert*-butylacetophenone (b.p. 135°/13 mm., semicarbazone m.p. 183-4°).

*p*-*tert*-Butyltoluene on acylation in the presence of anhydrous aluminum chloride gave only 2-methyl-4-*tert*-butylacetophenone (semicarbazone m.p. 197°).

The cadmium derivative from the Grignard reagent from *o*-bromo-*p*-*tert*-butyltoluene was allowed to react with the appropriate acid chlorides to give the corresponding ketones. Thus 2-methyl-5-*tert*-butylacetophenone was obtained in about forty per cent yield by this method. The product was superior to that obtained from acetic anhydride at low temperature (-35° to -50°).

2-Methyl-5-*tert*-butylpropiophenone (148°/18 mm.) was similarly obtained in about thirty-seven per cent yield (semicarbazone, m.p. 146.5°-147°).

A sixty-eight per cent yield of 2-methyl-5-*tert*-butylisobutyrophenone (b.p. 103°/2.4 mm.) was obtained by the same procedure.

The last compound prepared in this series of ketones from the organo-cadmium reagent was 2-methyl-5-*tert*-butyltrimethylacetophenone (b.p. 122.3°/3 mm.), obtained in about fifty-two per cent yield. None of these above mentioned four 2-methyl-5-*tert*-butyl ketones have been previously prepared.

Microfilm \$2.00; Xerox \$3.60. 65 pages.



# THE PURIFICATION AND DETERMINATION OF PURITY OF ACETONE TOGETHER WITH SOME OF ITS FUNDAMENTAL CONSTANTS

(L. C. Card No. Mic 58-5173)

Lawrence Joseph Prucino, Ph.D.  
Emory University, 1951

A great number of fundamental constants of compounds are recorded in the literature, but many of these constants were determined from relatively impure samples, or samples of unknown purity. The purpose of this work is to obtain very pure compounds (99.50 or greater mole per cent purity) for this laboratory and other laboratories, from which these fundamental constants may be more accurately redetermined.

This research embodies the purification of acetone by fractional distillation and the determination of the purity of this ketone, together with some of its fundamental constants. The data which were collected are: purity, boiling point, freezing point, density, surface tension, and index of refraction. The values determined for these properties are given in Table I. The purity of the acetone prepared and used for this study was of the order of 99.95 mole per cent. Approximately 450 milliliters of this purity were obtained.

TABLE I

## SOME FUNDAMENTAL CONSTANTS OF ACETONE

Property	Value
Boiling point at 675.1 mm. Hg	52.68°C.
Freezing point in air at 1 atm.	-94.871°C.
Refractive index $n_D^{25}$	1.3560
Density at 25.0°C.	0.7851 gr./cc.
Density at 30.0°C.	0.7793 gr./cc.
Density at 35.0°C.	0.7736 gr./cc.
Surface tension at 25.0°C.	22.81 dynes/cm.
Surface tension at 30.0°C.	22.10 dynes/cm.
Surface tension at 35.0°C.	21.45 dynes/cm.
Parachor <sup>a</sup> at 25.0°C.	161.8
Parachor at 30.0°C.	161.8
Parachor at 35.0°C.	161.8

<sup>a</sup>Calculated from density and surface tension

Microfilm \$2.00; Xerox \$5.80. 119 pages.

## A STUDY OF BASE-CATALYZED CONDENSATIONS OF METHYL DIMETHOXYACETATE

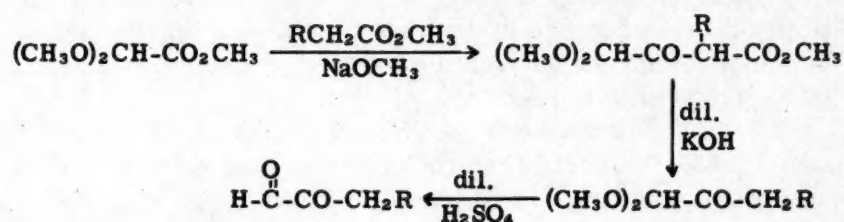
(L. C. Card No. Mic 58-5176)

Alfred Green Robinson, III, Ph.D.  
Emory University, 1955

The field of mixed-ester Claisen condensations has been of continuing interest to this laboratory. Methyl dimethoxyacetate is incapable of self-condensation, using sodium methoxide, and could possibly serve as the acylating component in Claisen condensations. Two previous instances of mixed-ester condensations, involving ethyl diethoxyacetate, were reported to give good yields of

cross-condensation products. This research was undertaken to determine: (1) the effectiveness of methyl dimethoxyacetate as an acylating agent in Claisen condensations; (2) the usefulness of the condensation products as sources of polyfunctional aldehydes.

A convenient synthesis, leading to overall yields of seventy per cent, of methyl dimethoxyacetate was devised. This ester was condensed, in the presence of sodium methoxide, with a series of six aliphatic esters. Yields of cross-condensation product ranged from fifty to eighty-five per cent. The condensation products were cleaved with base to give the corresponding  $\alpha$ -ketoacetals. Treatment of  $\alpha$ -ketoacetals with dilute acid gave the corresponding  $\alpha$ -ketoaldehydes. These compounds polymerized easily. The above reaction sequence is summarized below.



Seven aliphatic ketones were similarly condensed with methyl dimethoxyacetate to give thirty to sixty per cent yields of cross-condensation product. Attempts to hydrolyze the acetal function resulted in polymerization and formation of tars. Failure to isolate the aldehydes was attributed to the extreme reactivity of  $\alpha, \gamma$ -diketoaldehydes. Evidence of cleavage of the condensation products to regenerate the original ketone was observed.

Methyl dimethoxyacetate was successfully condensed with butyronitrile and fluorene. Attempted condensation with phenylacetone nitrile led only to highly-polymerized products. Nitromethane could not be acylated under the condensation conditions used. The acetal function of the fluorene condensation product was successfully hydrolyzed to the corresponding aldehyde. This product gave evidence of instability.

As a possible course for future work one  $\alpha$ -ketoacetal was reduced to the  $\alpha$ -hydroxyacetal in seventy per cent yield. This product was dehydrated, using iodine in benzene, to give the corresponding unsaturated acetal.

The overall result of this investigation shows that methyl dimethoxyacetate is an unusually effective acylating agent in Claisen condensations. Such condensations offer a convenient route for the synthesis of polyfunctional acetals. Microfilm \$2.00; Xerox \$4.20. 80 pages.



I. THE FREE RADICAL REACTIONS OF  
PERHALOALKANES AND UNSATURATED ALCOHOLS.  
II. THE PREPARATION AND REACTIONS  
OF SOME HALOGENATED CYCLOBUTANE  
CARBOXYLIC ACIDS.

(L. C. Card No. Mic 59-836)

Francis E. Rogers, Ph.D.  
University of Colorado, 1958

Supervisors: Professors J. D. Park and J. R. Lacher

The aim of this investigation is the extension of the basic knowledge concerning the synthesis of halogenated compounds with functional groups. In Part I, the approach is primarily through a study of the free radical reactions of perhaloalkanes and unsaturated alcohols. Part II is concerned with the inhibited thermal cyclization reactions of halogenated olefins.

Perhaloalkanes, such as  $\text{CF}_3\text{I}$ ,  $\text{C}_2\text{F}_5\text{I}$ ,  $\text{C}_3\text{F}_7\text{I}$ ,  $\text{CF}_2\text{ClCFClI}$  and  $\text{CF}_2\text{BrCFClBr}$ , were found to react with both allyl and propargyl alcohols in photochemical reactions. Peroxide catalysis was also effective, however the yields were poor. Quartz or Vycor vessels were not used in most of these reactions since it was found that "Double Tough" pyrex pipe admitted sufficiently energetic light to homolytically cleave the C-I bond of the following compounds;  $\text{CF}_3\text{I}$ ,  $\text{C}_2\text{F}_5\text{I}$ ,  $\text{C}_3\text{F}_7\text{I}$  and  $\text{CF}_2\text{ClCFClI}$ . Irradiation was carried on for a period of two weeks in most cases. The only adducts isolated from the allyl alcohol addition were of the general structure,  $\text{R}_f\text{CH}_2\text{CHICH}_2\text{OH}$ , while propargyl alcohol gave only  $\text{R}_f\text{CH}=\text{CICH}_2\text{OH}$  type molecules. The halohydrins prepared by this procedure were;  $\text{CF}_3\text{CH}_2\text{CHICH}_2\text{OH}$ ,  $\text{C}_2\text{F}_5\text{CH}_2\text{CHICH}_2\text{OH}$ ,  $\text{C}_3\text{F}_7\text{CH}_2\text{CHICH}_2\text{OH}$ ,  $\text{CF}_2\text{ClCFClCH}_2\text{CHICH}_2\text{OH}$ ,  $\text{CF}_2\text{BrCFClCH}_2\text{CHBrCH}_2\text{OH}$ ,  $\text{C}_3\text{F}_7\text{CH}=\text{CICH}_2\text{OH}$  and  $\text{CF}_3\text{CH}=\text{CICH}_2\text{OH}$ . The structure of each adduct was proved by conversion to the glycol via the epoxide. All the glycols prepared gave a positive periodic acid test as expected for vicinal glycols. The nature of the halohydrin formed in each case indicated that the general structure of the product is independent of the attacking species, i.e. no isomeric halohydrins of type,  $\text{CH}_2\text{I}-\text{CH}(\text{R}_f)-\text{CH}_2\text{OH}$  were obtained.

The order of reactivity for the perfluoroalkyl iodides appears to be  $\text{C}_3\text{F}_7\text{I} > \text{C}_2\text{F}_5\text{I} > \text{CF}_3\text{I}$ .

The epoxide  $\text{C}_2\text{F}_5\text{CH}_2\text{CH}-\text{CH}_2$  was reduced to the secondary alcohol  $\text{C}_2\text{F}_5\text{CH}_2\text{CH}(\text{OH})\text{CH}_3$  with lithium aluminum hydride. An attempt to reverse the epoxide ring opening using a lithium aluminum hydride-aluminum chloride solution failed; only the secondary alcohol was obtained.

The halohydrins  $\text{R}_f\text{CH}=\text{CICH}_2\text{OH}$  (where  $\text{R}_f = \text{CF}_3$  and  $\text{C}_3\text{F}_7$ ) were reduced to the corresponding unsaturated alcohols  $\text{R}_f\text{CH}=\text{CHCH}_2\text{OH}$ . Cis and trans isomers were separated by gas chromatography.

Diethyl itaconate has been found to co-dimerize with  $\text{CF}_2=\text{CF}_2$ ,  $\text{CF}_2=\text{CFCl}$ , and  $\text{CF}_2=\text{CCl}_2$  quite readily at  $180^\circ$  to form cyclobutane derivatives of the type  $\text{CX}_2\text{CX}_2\text{CH}_2\text{C}(\text{COOEt})\text{CH}_2\text{COOEt}$ . The alternate product,  $\text{CX}_2\text{CX}_2\text{CH}(\text{COOEt})\text{C}(\text{CH}_3)\text{COOEt}$  arising from a rearrangement of diethyl itaconate to diethyl citraconate before reaction was ruled out on the basis of the relative inactivity of diethyl citraconate in cyclic dimerization reactions and recovery of diethyl itaconate from the reaction mixture. By an indirect method it is shown that the structure of the dimer

resulting from  $\text{CF}_2=\text{CFCl}$  and  $\text{CF}_2=\text{CCl}_2$  is probably  $\text{CX}_2\text{CF}_2\text{CH}_2\text{C}(\text{COOEt})\text{CH}_2\text{COOEt}$ , (where  $\text{X} = \text{F}, \text{Cl}$ ).

Prolonged basic hydrolysis of these dimers gave the dibasic acids in good yields. Acid hydrolysis of these diesters gave only a half ester and some diacid. The diacid,  $\text{CCl}_2\text{CF}_2\text{CH}_2\text{C}(\text{COOH})\text{CH}_2\text{COOH}$  is even remarkably stable toward hot concentrated sulfuric acid. On the other hand, some halogenated cyclobutane derivatives undergo ring cleavage when subjected to these conditions.

The crude diacid,  $\text{CFClCF}_2\text{CH}_2\text{C}(\text{COOH})\text{CH}_2\text{COOH}$  was separated into two fractions which are evidently geometric isomers.

The Hunsdiecker reaction was successfully applied to the half ester,  $\text{CCl}_2\text{CF}_2\text{CH}_2\text{C}(\text{COOEt})\text{CH}_2\text{COOH}$  to give  $\text{CCl}_2\text{CF}_2\text{CH}_2\text{C}(\text{COOEt})\text{CH}_2\text{Br}$ .

The diester  $\text{CF}_2\text{CF}_2\text{CH}_2\text{C}(\text{COOEt})\text{CH}_2\text{COOEt}$  was reduced to the corresponding glycol.

Microfilm \$2.00; Xerox \$6.80. 144 pages.

THE DEHALOGENATION OF 2,4-DIBROMO-  
2,4-DIMETHYL-3-PENTANONE

(L. C. Card No. Mic 58-5181)

Benjamin Harper Smith, Jr., Ph.D.  
Emory University, 1951

The dehalogenation of  $\alpha, \alpha'$ -dihalo ketones has been studied for many years as a possible method for the preparation of cyclopropanones. This investigation was concerned with the dehalogenation of 2,4-dibromo-2,4-dimethyl-3-pentanone (I) with mercury in anhydrous ethyl ether at room temperature. Emphasis was placed upon characterizing the monomeric product obtained from this reaction.

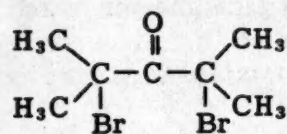
The dehalogenation reactions consisted of 0.37 molar ether solutions of the dibromo ketone (25 g. in 250 ml. of ether) or 0.12 molar solutions (50 g. in 1500 ml. of ether). There was no noticeable difference in the rate of debromination nor in the yield of monomeric product (15 to 20 per cent). With efficient stirring the dehalogenation was 98 to 99 per cent complete in 36 hours. The monomeric dehalogenated product was isolated by distilling the ethereal solution in a Claisen flask at atmospheric pressure and the residue under reduced pressure. Characteristics of the product were b.p.  $38-40^\circ$  (6.5-8.0 mm.),  $n_D^{20}$  1.4270-1.4285, mol. wt. 110-115 and wavelength of maximum absorption (in iso-octane) of 3285 Å with an extinction coefficient of 27.1.

Reduction of the monomeric dehalogenated product with either lithium aluminum hydride or aluminum *iso*-propoxide gave an alcohol. Its 3,5-dinitrobenzoate was not identical with the corresponding derivatives of 2,2,3-trimethyl-1-butanol (IV) or 2,4-dimethyl-3-pentanol (V). These respective alcohols would correspond to reduction of the carbonyl group and ring reduction of the  $\text{C}_1-\text{C}_2$  or  $\text{C}_2-\text{C}_3$  bond of 2,2,3,3-tetramethyl-1-cyclopropanone (II).

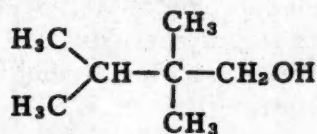
2,4-Dimethyl-1-penten-3-one (III), obtained by the dehydrobromination of 2-bromo-2,3-dimethyl-3-pentanone with refluxing pyridine, was found to be identical with the monomeric dehalogenated product. This was established through their 2,4-dinitrophenylhydrazones, semicarbazones



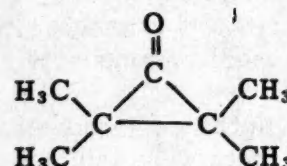
and ultraviolet absorption spectra. Reduction of the  $\alpha,\beta$ -unsaturated ketone with lithium aluminum hydride produced 2,4-dimethyl-1-penten-3-ol (VI) which was identical with the corresponding reduced monomeric dehalogenated product.



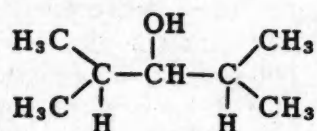
I



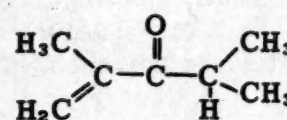
IV



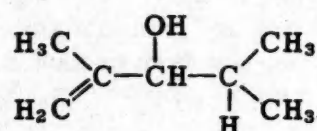
II



V

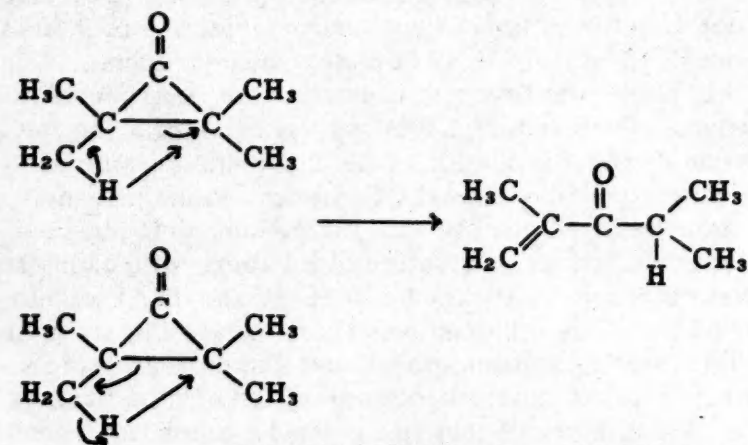


III



VI

It is postulated that the cyclopropanone (II), as formed, is converted to the isomeric  $\alpha,\beta$ -unsaturated ketone by fission of the C<sub>2</sub>-C<sub>3</sub> bond and a transfer of a methyl hydrogen to one of these carbon atoms. This rearrangement occurs either soon after the cyclopropanone is formed or by a pyrolytic process during isolation.



Microfilm \$2.00; Xerox \$4.00. 71 pages.

# THE SYNTHESIS AND THERMAL DECOMPOSITION OF 3,3-DISUBSTITUTED- $\Delta^1$ -PYRAZOLINES

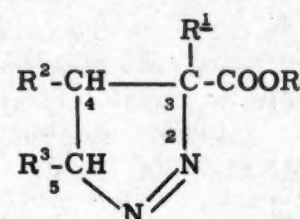
(L. C. Card No. Mic 58-3123)

Harry Raymond Snyder, Jr., Ph.D.  
Boston University Graduate School, 1958

Major Professor: Professor J. Philip Mason

The system shown at the top of this page has been studied:

$\Delta^1$ -Pyrazolines were prepared in which one or more of the groups R, R<sup>1</sup>, R<sup>2</sup>, R<sup>3</sup> are alkyl or phenyl and the other groups are hydrogen. In addition, the molecule was modi-



fied by the use of four other activating groups in the place of the carboxyl group, i.e. -CN, -CONH<sub>2</sub>, -COCH<sub>3</sub>, and -NO<sub>2</sub>. The compounds were decomposed thermally and the kinetics of the decomposition was followed by measuring the volume of nitrogen evolved as a function of time. From the data obtained, the rate constants and energies of activation were calculated. The purpose of the investigation was to determine the effects upon the rate constants and energies of activation produced by the alteration of the molecule at the above-indicated positions.

The pyrazolines were prepared by the addition of diazomethane to the appropriate olefin, or by the addition of the appropriate diazoalkane to ethyl methacrylate.

The following table summarizes the compounds prepared and the kinetic data obtained.

Summary of Kinetic Data

Compound	k min. <sup>-1</sup> at 109.5°C.	k min. <sup>-1</sup> (°C.)	E <sub>a</sub> (kcal.)
3-Cyano-3-methyl- $\Delta^1$ -pyrazoline	0.0461	0.0048(88.75)	30
Ethyl 5-Propyl-3-methyl- $\Delta^1$ -pyrazolin-3-carboxylate	0.0440	0.0054(88.75)	28
Ethyl 5-Ethyl-3-methyl- $\Delta^1$ -pyrazolin-3-carboxylate	0.0438	0.0048(88.75)	28
Ethyl 3,5-Dimethyl- $\Delta^1$ -pyrazolin-3-carboxylate	0.0435	0.0055(88.75)	27
3-Aceto-3-methyl- $\Delta^1$ -pyrazoline	0.0104	0.0496(125.9)	29
Methyl 3-Methyl- $\Delta^1$ -pyrazolin-3-carboxylate	0.0062	0.0431(125.9) 0.0435(125.9)	36
3-Nitro-3-methyl- $\Delta^1$ -pyrazoline	0.0061	0.0290(125.9)	29
Ethyl 3-Methyl- $\Delta^1$ -pyrazolin-3-carboxylate	0.0060	0.0341(125.9)	32
n-Propyl 3-Methyl- $\Delta^1$ -pyrazolin-3-carboxylate	0.0058	0.0351(125.9)	33
n-Butyl 3-Methyl- $\Delta^1$ -pyrazolin-3-carboxylate	0.0058	0.0357(125.9)	34
Isopropyl 3-Methyl- $\Delta^1$ -pyrazolin-3-carboxylate	0.0053	0.0343(125.9) 0.0341(125.9)	34
t-Butyl 3-Methyl- $\Delta^1$ -pyrazolin-3-carboxylate	0.0041	0.0256(125.9) 0.0258(125.9)	34
Ethyl 3-Ethyl- $\Delta^1$ -pyrazolin-3-carboxylate*	0.0039***	0.0164(125.9)	28
Ethyl 3,4-Dimethyl- $\Delta^1$ -pyrazolin-3-carboxylate	0.0020	0.0122(125.9)	34
3-Carbamyl-3-methyl- $\Delta^1$ -pyrazoline**	0.0019***	0.0012(125.9)	34

\* Second k = 0.0758 min.<sup>-1</sup> at 143.96°C., t<sub>1/2</sub> = 9 min.

\*\* Second k = 0.0077 min.<sup>-1</sup> at 143.95°C., t<sub>1/2</sub> = 89 min.

\*\*\* calc.

Note: An attempt to prepare ethyl 3-phenyl- $\Delta^1$ -pyrazolin-3-carboxylate resulted in a pyrazoline which decomposed noticeably at room temp. and vigorously at steam bath temp.



In order to facilitate a discussion of the conclusions drawn from the kinetic data, attention is focused upon the rates of nitrogen evolution at 109.5°C. since all but two of the pyrazolines were studied at this temperature. The nitrogen evolution rates for ethyl 3,4-dimethyl- $\Delta^1$ -pyrazolin-3-carboxylate and 3-carbamyl-3-methyl- $\Delta^1$ -pyrazoline at this temperature are calculated values. The rate of nitrogen evolution of ethyl 3-methyl- $\Delta^1$ -pyrazolin-3-carboxylate is arbitrarily taken as a convenient reference point.

An examination of the kinetic data shows that there are eight major changes which influence the rate of nitrogen evolution:

I. There are four ways by which the nitrogen evolution can be reduced:

- A. The use of tert.-butyl alcohol in the carboxyl group at position 3.
- B. The substitution of an ethyl group for the methyl group at position 3.
- C. The substitution of a methyl group at position 4.
- D. The use of a carbamyl group in the place of the carboxyl group at position 3.

II. There are four ways by which the rate of nitrogen evolution can be increased:

- A. The substitution of the carboxyl group at position 3 by an aceto group.
- B. The substitution of an alkyl group at position 5.
- C. The use of a cyano group to replace the carboxyl group at position 3.
- D. The replacement of the methyl group at position 3 by a phenyl group.

Microfilm \$2.00; Xerox \$6.60. 138 pages.

#### REACTIONS OF SOME UNSATURATED COMPOUNDS

(L. C. Card No. Mic 59-812)

Richard Durant Stacy, Ph.D.  
University of Colorado, 1958

Supervisor: Associate Professor John S. Meek

#### PART I

The oxidative scission of vicinal hydroxyl, hydroxyl-carboxyl and hydroxyl-amino groups in a molecule by reagents such as periodic acid and lead tetraacetate is a well-known and much used reaction in organic chemistry. In order to investigate whether these reagents would react similarly with hydroxyl groups separated from each other by a vinylene ( $-\text{CH}=\text{CH}-$ ) linkage, the compounds *cis*- and *trans*-2-butenediol-1,4 were treated with these reagents.

Two organic products would be anticipated from this vinylogous cleavage, formaldehyde and acetylene. Positive evidence for the presence of formaldehyde in the reaction products was obtained for both the *cis*- and *trans*-isomers. However, no acetylene was produced and the anticipated vinylogous oxidative scission was not obtained. A postulated reaction path to explain the presence of formaldehyde is discussed.

#### PART II

The N-phenylmaleimides have been shown to have excellent dienophilic properties in the diene synthesis in previous investigations at this University. Therefore, a molecule containing two phenylmaleimido groupings should lead to polymer formation when reacted in a diene synthesis with a molecule containing two suitably-situated dienic moieties.

As a continuation and further elucidation of previous work on this problem, the ethylene glycol;  $\beta,\beta'$ -dihydroxy-ethyl ether 1,3-propanediol and 1,4-butanediol esters of p-maleimidobenzoic acid were prepared and characterized. These esters were prepared from p-maleimidobenzoyl chloride and the diol in an inert solvent.

The esters were heated with 1,8-diphenyloctatetraene in chloroform and the polymeric products were isolated and purified by precipitation with methanol. Molecular weight determinations on the polymers indicated that the degree of polymerization was rather small, yielding only dimers and trimers as polyadducts. Each of the amorphous, powdery products neither melted nor decomposed below 300°.

#### PART III

One of the properties to which rubber owes its peculiar characteristics is the all-*cis* arrangement of the double bonds in the linear molecular structure.

A polymerization reaction leading to exclusive *cis*-addition of the monomeric units might occur if, structurally, these monomeric units precluded any possibility of *trans*-addition. This was one of the purposes for an investigation into the synthesis and characterization of 9,10-dihydro-9,10-ethano-11,12-dimethylenanthracene.

This diene was formed, along with the compound 9,10-dihydro-9,10-ethano-11,12-(3',4')-furanoanthracene, by a base-catalyzed elimination of the bis-p-toluenesulfonate of 9,10-dihydro-9,10-ethano-11,12-dimethylanthracene. The diene reacted readily with maleic anhydride to give the expected adduct. Oxidation of the diene with ozone led to the compound, 9,10-dihydro-9,10-ethano-11,12-diketanthracene. This diketone was characterized by its analysis, infra-red spectrum and quinoxaline derivative.

Free-radical-induced polymerization of this diene resulted in a mixture of thermally-stable, amorphous products, none of which contained more than ten monomeric units. No rubber-like properties were observed in this mixture of products.

#### PART IV

The pyrolysis and dehydrogenation with sulfur of 9,10-dihydro-9,10-ethanoanthracene and 9,10-dihydro-9,10-ethenoanthracene was studied.

Pyrolysis of the 9,10-ethano compound led to a thermal reversal of the diene synthesis, giving ethylene and anthracene. The action of sulfur on the 9,10-ethano compound at high temperatures resulted in thermal degradation of the molecule to anthracene, carbon and hydrogen sulfide rather than to the expected 9,10-etheno compound.

The compound 9,10-dihydro-9,10-ethenoanthracene was found to be quite stable under pyrolytic conditions. However, upon treatment of this compound with sulfur at elevated temperatures, extensive decomposition occurred and some acetylene was found.

Microfilm \$2.25; Xerox \$7.80. 169 pages.



THE SYNTHESIS AND PROPERTIES OF  
1,2-DIKETOPYRACENE AND OTHER  
ACENAPHTHENE DERIVATIVES

(L. C. Card No. Mic 59-813)

Frederick Butler Stocker, Ph.D.  
University of Colorado, 1958

Supervisor: Associate Professor Henry J. Richter

In the past forty years numerous workers have attempted unsuccessfully to close a 5-membered ring across the *peri* positions of acenaphthene. In this research we have accomplished such a ring closure by reacting acenaphthene with oxalyl bromide in the presence of aluminum bromide. The product, 1,2-diketopyracene, is readily separated from the reaction mixture by extraction with aqueous sodium bisulfite. The yield in the first successful preparation was less than 2% but it was found that by going to higher dilutions the yield could be increased to 16%. When aluminum chloride was substituted for aluminum bromide in this preparation, no 1,2-diketopyracene was formed. This diketone formed a quinoxaline and could be reduced to pyracene.

By reaction with phenylmagnesium bromide, 1,2-diketopyracene formed a glycol which was cleaved with lead tetraacetate to form 5,6-dibenzoylacenaphthene, m.p. 208-209°.

An isomeric dibenzoylacenaphthene, m.p. 148-149°, was obtained by reacting acenaphthene with two equivalents of benzoyl chloride in the presence of aluminum chloride. The dioxime of this diketone when subjected to the conditions of the Beckmann rearrangement formed a diamide, m.p. 277-278°. This substance resisted hydrolysis by dilute acids but 70% sulfuric acid caused cleavage giving benzoic acid and an amine. The amine had the composition of an amino-benzamidoacenaphthene and when reacted with benzoyl chloride in pyridine was converted back to the original diamide. With 100% phosphoric acid as the hydrolysis agent more than one equivalent of benzoic acid was formed showing that the original product was a dibenzamide. This was shown to be 3,6-dibenzamidoacenaphthene by comparison with an authentic sample prepared from 3,6-diaminoacenaphthene and benzoyl chloride.

A diacetylacenaphthene, m.p. 149-150°, was reported in 1931 to be 5,6-diacetylacenaphthene. This work was repeated and found to be in error as the compound did not possess the properties described in the literature. The dioxime of this diacetylacenaphthene was rearranged to a diamide, m.p. 300-301°, which was not similar to the reported diamide, m.p. 227-228°. In view of the results obtained with dibenzoylacenaphthene, the 3,6-isomer was indicated. This was shown to be the case when it was demonstrated that the diamide obtained by rearrangement of the dioxime of the diacetylacenaphthene is identical with the 3,6-diacetanidoacenaphthene prepared from the known 3,6-diaminoacenaphthene and acetic anhydride.

Microfilm \$2.00; Xerox \$5.40. 106 pages.

BECKMANN REARRANGEMENTS AND  
OTHER REACTIONS IN THE  
BICYCLO(2.2.1)HEPTANE SERIES

(L. C. Card No. Mic 59-148)

Chester Trivette, Jr., Ph.D.  
Duke University, 1958

Supervisor: Dr. P. Wilder, Jr.

The Beckmann rearrangement of 9-keto-tetrahydro-exo-dicyclopentadiene oxime and 9-keto-tetrahydro-endo-dicyclopentadiene oxime yielded a nitrile in each case. The structure of these nitriles was not determined. However, infrared spectra of both compounds indicated the presence of an *exo*-methylene type carbon-carbon double bond. The formation of such a structure would require cleavage of the oxime between C<sub>9</sub> and C<sub>10</sub>.

The stereochemical configuration of the cyclopentadiene-β-nitrostyrene adduct was established through reference to a compound of known configuration, *exo*-2-phenyl-endo-3-carboxy-bicyclo(2.2.1)heptane. Brominative decarboxylation of this acid of known configuration, followed by reduction of the resulting bromo compound to the hydrocarbon, yielded *exo*-2-phenyl-bicyclo(2.2.1)heptane. Catalytic reduction of the cyclopentadiene-β-nitrostyrene adduct, followed by reduction of the nitro group, gave 2-phenyl-3-amino-bicyclo(2.2.1)heptane. Treatment of this amine with nitrous acid, oxidation of the resulting alcohol to the ketone, and reduction of the ketone by the Wolff-Kishner method yielded a 2-phenyl-bicyclo(2.2.1)heptane which gave an infrared spectrum identical with that of *exo*-2-phenyl-bicyclo(2.2.1)heptane.

Addition of hydrobromic acid to norbornadiene at elevated temperature yielded a dibromo compound, which is a bicyclo(2.2.1)heptane derivative. Addition of methanol and water to norbornadiene gave 3-methoxy-nortricyclene and 3-hydroxy-nortricyclene, respectively. The structure of the hydroxy-formate produced by addition of performic acid to norbornadiene was established as 3-hydroxy-5-formyl-nortricyclene by hydrolysis to 3,5-dihydroxy-nortricyclene, a known compound. Nitrosyl chloride reacted with norbornadiene to yield a bicyclo(2.2.1)heptene derivative. The structure was determined by conversion of the nitrosyl chloride derivative to the known 2,4-dinitrophenylhydrazine derivative of 2-keto-bicyclo(2.2.1)heptene-5. An infrared spectrum of the nitrosyl chloride derivative was in agreement with these findings.

Microfilm \$2.00; Xerox \$5.00. 100 pages.

REACTION OF SOME 3-HYDROXY-1,4-PYRONES  
AND ANALOGS WITH ACRYLONITRILE  
AND OTHER ACRYLIC DERIVATIVES

(L. C. Card No. Mic 59-230)

Swiatoslaw Trofimenko, Ph.D.  
Northwestern University, 1958

Supervisor: Charles D. Hurd

Two conflicting reports on cyanoethylation of kojic acid have been investigated. That of L. L. Woods was



shown to be in error, as the compound thought by him to be a new derivative was not obtainable in the present study, whereas a compound from another reaction that was claimed by Woods to be identical to the former was proved to be unreacted kojic acid. The findings of R. J. Sims were confirmed in essence; an abnormal cyanoethylation product (compound A) was found to be formed, constituted of two molecules of kojic acid and one of acrylonitrile, with the cyano group hydrolyzed in the process of isolation.

This abnormal cyanoethylation reaction was investigated. Two series of compounds were synthesized, one containing a 3-hydroxy-1,4-pyrone system and another containing similar structural features. Some of these compounds were new, and others were prepared with slight improvement of existing procedures. When these compounds were subjected to cyanoethylating conditions two types of behavior were observed:

1. Abnormal cyanoethylation, in which two molecules of the pyrone condensed with one molecule of acrylonitrile. This was found to happen with monocyclic pyrones of the pyromeconic acid type with a hydroxymethyl, chloromethyl or methyl substituent at the 6-position.

2. Non-reaction. Compounds failing to react were: ethers of 3-hydroxy-1,4-pyrones, 6-substituted derivatives of kojic acid, 3-hydroxychromone, 3-hydroxythiachromone, 2-hydroxy-1,4-naphthoquinone and tropolone.

The reaction conditions for the abnormal cyanoethylation of  $\alpha$ -deoxykojic acid were investigated in detail. The reaction was found to be independent of the solvent or base used provided the latter was in less than equivalent amount, the optimum condition being about 0.5 equivalent. The major product from the above reaction, called D-I, was used as a model for structural study of the abnormal cyanoethylation reaction.

D-I had the formula  $C_{15}H_{15}NO_6$ . It was a mono-enol of pKa 9-10. From the study of infrared and nuclear magnetic resonance spectra, formation of derivatives and degradative studies it was found to contain two hydroxyls, a nitrile group, a ketonic carbonyl devoid of  $\alpha$  methylene groups and quite hindered sterically, an ether linkage, and a pyrone system. Of the two hydroxyls, one was enolic and one was assigned as a tertiary alcohol, possibly at a bridgehead.

Consideration of the evidence available indicated that the beta carbon of the acrylonitrile molecule is linked to the 6-position of the pyrone system, and the alpha carbon to the 2-position of a "degenerate" pyrone system. The nature of D-I was elucidated by physical and chemical evidence and by mechanistic considerations. A detailed mechanism has been proposed.

The structure advanced for D-I was 2-(3-hydroxy-4-oxo-6-methyl- $\gamma$ -pyran-2-yl)methyl-3-oxo-4-hydroxy-1-methyl-6-oxabicyclo[2.2.1]heptane-2-carbonitrile. Extrapolation of this structure led to the assignment of structures for the analogous compounds formed through abnormal cyanoethylation. Thus the structure proposed for A was 2-(3-hydroxy-4-oxo-6-(hydroxymethyl)- $\gamma$ -pyran-2-yl)methyl-3-oxo-4-hydroxy-1-(hydroxymethyl)-6-oxabicyclo[2.2.1]heptane-2-carboxylic  $\gamma$ -lactone.

A minor product was also isolated from the reaction where D-I was formed. It is thought to be a configurational isomer of D-I. Also, while reaction of  $\alpha$ -deoxykojic acid with acrylamide produced a compound which could be readily correlated to D-I, the main product obtained from the corresponding reaction with methyl acrylate could not be so correlated.

Some unsuccessful attempts other than cyanoethylation were made to introduce a cyanoethyl group into  $\alpha$ -deoxykojic acid. Microfilm \$2.15; Xerox \$7.60. 164 pages.

## A STUDY OF THE SYNTHESIS OF TRIACID TRIGLYCERIDES

(L. C. Card No. Mic 58-5186)

William Harrison Watson, Ph.D.  
Emory University, 1952

The preparation of triacid triglycerides of known structure is warranted as an aid to the elucidation of the composition of natural fats. Glycerides are used in the cosmetic and pharmaceutical industries and it is possible, by varying the acid groups present in a glyceride, to obtain properties that could conceivably be useful in these fields.

The literature contains several methods for the preparation of triacid triglycerides but only one has been shown to give accurate results and to be synthetically feasible. This method for the preparation of triacid triglycerides is as follows: a 1-monoglyceride is allowed to react with trityl chloride in the presence of quinoline. This produces a 1-acyl-3-tritylglycerol. Following esterification of the 2-hydroxyl group with a second acid chloride in the presence of an organic base, the trityl group is removed by cleaving with either catalytic hydrogen or with hydrogen chloride in an inert solvent. The former method of cleavage produces a 1,2-diacid diglyceride. In this work attempts to use this method of cleavage were unsuccessful. The cleavage of the trityl group by hydrogen chloride causes the acid group on the 2-hydroxyl group to rearrange to the 3-position producing a 1,3-diacid diglyceride. Either of these two compounds are then esterified with a third acid chloride to produce a triacid triglyceride. In this work all of the triacid triglycerides were prepared from the 1,3-diacid diglycerides.

The experimental procedures reported in the literature for the preparation of triacid triglycerides were found to be unsatisfactory when applied to the preparation of the compounds which were of interest to this work. These experimental procedures have been thoroughly investigated and extensively modified to a point where consistent results could be obtained.

In this work only saturated straight chain fatty acids containing an even number of carbon atoms ranging from  $C_6$  to  $C_{18}$  have been employed to prepare diacid and triacid glycerides. A series of six diacid diglycerides has been prepared containing three new examples of this class of compounds. These were 1-lauryl-3-caprylglycerol, 1-palmityl-3-caprylglycerol, and 1-myristyl-3-laurylglycerol. Twenty-one triacid triglycerides, including four compounds previously reported, have been prepared. The data as reported in the literature for 1-lauryl-2-caprylyl-3-myristylglycerol have been found to be erroneous. The correct data are given.

An appendix is included which lists all the reported diacid and triacid glycerides that have been prepared by reliable methods through the year 1951.

Microfilm \$2.00; Xerox \$4.00. 72 pages.



THE PREPARATION AND REACTIONS OF A  
4,5-ACENAPHTHENEQUINONE DIIMIDE  
AND RELATED COMPOUNDS

(L. C. Card No. Mic 59-845)

Berton Charles Weberg, Ph.D.  
University of Colorado, 1958

Supervisor: Associate Professor Henry J. Richter

This work was conducted in order to produce a true quinone of acenaphthene, since acenaphthenequinone is not a true quinone but rather a 1,2-diketone.

When 5-benzenesulfonamidoacenaphthene is mononitrated, the nitro group enters position 4, affording a route to the 4,5-disubstituted derivatives. 4-Nitro-5-aminoacenaphthene, although rather inert, can be reacted with benzenesulfonyl chloride to give 4-nitro-5-benzenesulfonamidoacenaphthene. These methods were used to prepare and characterize 4,5-dibenzenesulfonamidoacenaphthene for subsequent oxidation to 4,5-acenaphthenequinonedibenzene-sulfonimide. The oxidation was carried out at room temperature in anhydrous ether with lead tetraacetate. The deep red quinone diimide which resulted was characterized by analysis, infra-red spectrum, and by reduction to the original 4,5-dibenzenesulfonamidoacenaphthene. Attempted addition of hydrogen chloride to the quinone diimide and/or treatment with hot pyridine caused a novel rearrangement to 4,5-dibenzenesulfonamidoacenaphthylene. The structure of this compound was further established by its synthesis. This was accomplished by monobromination of 4,5-dibenzenesulfonamidoacenaphthene with N-bromo-succinimide, and elimination of hydrogen bromide with base. The 4,5-dibenzenesulfonamidoacenaphthylene was also hydrogenated to the original 4,5-dibenzenesulfonamidoacenaphthene. Mechanisms for the rearrangement involving both acid and base catalysis are suggested.

When 1-benzenesulfonamidonaphthalene was treated with lead tetraacetate at elevated temperature, alphanaphthoquinonemonobenzenesulfonimide was formed. A similar reaction involving benzenesulfonanilide was unsuccessful. The oxidation of 5-benzenesulfonamidoacenaphthene with lead tetraacetate formed a mixture which was sensitive to solvents, and chromatographic techniques were unsatisfactory. A partial separation was achieved by crystallization techniques and yielded a white component and a yellow component. The white product could be converted to the yellow substance with the usual acetylating agents. Analysis and infra-red spectra did not indicate any particular structures.

Preparation of a quinone monoimide involving positions 4 and 5 of the acenaphthene molecule was considered to be possible. 4-Nitro-5-benzenesulfonamidoacenaphthene was catalytically reduced to the corresponding amine, and then treated with nitrous acid. The diazonium salt was decomposed with steam, and the product was found to contain only carbon, hydrogen and nitrogen. It was shown to be a triazolo acenaphthene. The benzenesulfonyl group was eliminated as benzenesulfonyl chloride. A similar reaction with 4-amino-5-benzamidoacenaphthene also produced a triazole but the benzoyl group was not eliminated in the reaction. The benzoyl group was hydrolyzed in acid to obtain the same triazole which resulted from the similar treatment of 4-amino-5-benzenesulfonamidoacenaphthene with nitrous acid. 4,5-Triazoloacenaphthene was also prepared

by treatment of 4,5-diaminoacenaphthene with nitrous acid. Microfilm \$2.00; Xerox \$5.20. 104 pages.

THE PREPARATION AND CLEMMENSEN  
REDUCTION OF SOME ALIPHATIC ALDEHYDES

(L. C. Card No. Mic 58-5193)

Earl Willan Wilson, Ph.D.  
Emory University, 1949

One of the standard widely used synthetic reactions is the Clemmensen reduction. It enables one to go directly from a wide variety of carbonyl compounds to the corresponding saturated hydrocarbons without the necessity of preparing or isolating any intermediate products.

The reaction has been widely used with aromatic aldehydes, mixed aryl-alkyl ketones and some aliphatic ketones. Although Clemmensen records the reduction of heptaldehyde to heptane in his original paper, the method has not met with favorable results in the field of aliphatic aldehydes. There have been only scattered reports of its use for this purpose.

The alternatives that one has to effect such a similar reaction are the use of catalytic hydrogenation or the use of the hydrazine and alkali treatment (Wolf-Kishner reduction).

Clemmensen's original results on the reduction of normal-heptaldehyde could not be reproduced in preliminary experiments conducted in this laboratory. Because of these conflicting data and the usefulness of such a method if it could be perfected, it was considered desirable to re-investigate the method with aldehydes of various types.

Isolated cases are reported in which the method has been used successfully in the reduction of aliphatic aldehydes. If the extent of its applicability were established, then the method might become a more valuable tool.

The problem investigated was the applicability of the Clemmensen reduction to normal aliphatic aldehydes and aldehydes with branching in the alpha position. The aldehydes investigated were chosen particularly to represent types of varying degrees of reactivity toward the principal side reactions considered possible.

The problem consisted of two parts (1) the synthesis of the desired aldehydes and (2) the treatment of these aldehydes with the standard Clemmensen reduction.

Normal heptaldehyde, previously reported as being reduced to heptane with a seventy eight per cent yield, was available and chosen as a representative aldehyde of its type.

A number of alpha phenyl substituted aldehydes were prepared, as representative of aldehydes with one hydrogen in the alpha position. They were prepared from the suitable glycidic esters. These, in turn, were obtained without difficulty, by the condensation of methyl chloroacetate and the suitable phenyl ketones, using sodium methoxide as a catalyst. The use of this now readily available catalyst is recommended upon the basis of the high yields obtained. The glycidic esters easily form sodium salts with sodium methoxide and dry methyl alcohol. The salts are readily neutralized and spontaneously decarboxylate to the desired aldehydes.

Trimethyl acetaldehyde (pivalic aldehyde) was prepared



as an aldehyde completely substituted in the alpha position. It was made by the reaction of a formate ester with tertiary butyl magnesium bromide. The ortho-formate synthesis was also attempted but the method proved unsatisfactory.

In the reduction of the normal chained aldehydes the work of Ogletree was confirmed. A maximum yield of approximately nine per cent of heptane was obtained. The remaining material underwent condensation and polymerization.

The series of alpha-phenyl substituted aldehydes was also found to be unsuitable for Clemmensen reduction. The yields of the hydrocarbon varied but were in the order of only four per cent. The principal reduction products obtained were more complex alcohols and olefins. These were isolated in yields of twenty to forty per cent. Alcohols are not in general produced in the Clemmensen process. Starting aldehydes amounting to as much as sixty-seven per cent were recovered unchanged from the reduction products of the substituted aldehydes.

The completely branched pivaldehyde, which cannot undergo the aldol type of condensation, was found to be reduced by the Clemmensen method. A yield of approximately sixty per cent was obtained. No side reaction of any magnitude occurred. Essentially unchanged aldehyde accounted for the remainder of the starting material, accompanied by only a slight amount of residue.

It may be concluded that aliphatic aldehydes in general are not successfully reduced by the Clemmensen method. Under the conditions of the method the primary products are the result of a competing condensation when this is possible, that is whenever there is an alpha hydrogen present in the molecule. This condensation is more rapid than the reduction and only very small amounts of the saturated hydrocarbons are produced.

When the aldehyde has no alpha hydrogens and this competition, therefore, does not exist, Clemmensen reduction will occur. Microfilm \$2.00; Xerox \$3.00. 53 pages.

#### THE REACTION OF PYRIDOTRIAZOLE WITH ORGANIC ACIDS

(L. C. Card No. Mic 59-623)

Lionel Thomas Wolford, Ph.D.  
Tulane University, 1958

Chairman: J. H. Boyer

The hydrazone of 2-benzoylpyridine was prepared and upon oxidation with silver oxide gave 1-phenylpyridotriazole. Oxidation of the hydrazone of isoquinoline-3-aldehyde with silver oxide resulted in the isolation of the azine of isoquinoline-3-aldehyde instead of the corresponding triazole.

The observation, made previously, that pyridotriazole was decomposed by cold concentrated sulfuric acid indicated that a reaction might occur with weaker acids at elevated temperatures. Mixtures of pyridotriazole and aliphatic or aromatic acids reacted at temperatures ranging from 65-110°. Further investigation showed that the reaction occurred with the evolution of nitrogen and the formation of esters of 2-pyridylmethanol. A similar reac-

tion between 1-phenylpyridotriazole and organic acids required more drastic conditions. Pyridotriazole also reacted with phenol at 140° with the evolution of nitrogen and the formation of phenyl-2-picoly ether. A study of the ultraviolet spectra of neutral and acidic solutions of pyridotriazole suggested that pyridotriazole underwent a structural change in acidic environment. Presumably the intermediates in the aforementioned reactions were diazoalkyls which reacted with organic acids in the normal manner.

Since diazoalkyls have also been suggested as intermediates in the decomposition of N-alkyl-N-nitrosoamides, the preparation and subsequent decomposition of N-2-picoly-N-nitroso-p-nitrosobenzamide were carried out. The isolation of the expected 2-pyridylmethyl-p-nitrobenzoate from this decomposition supported the proposal that diazoalkyls are intermediates in the reaction of pyridotriazole with organic acids. Phenyl-2-pyridylmethanamine was prepared by the reduction of phenyl-2-pyridyl ketoxime. This amine was converted to the corresponding benzamide but all attempts to nitrosate the benzamide failed. When 2-benzoylpyridine was subjected to the conditions of the Leuckart reaction, a probable formamide intermediate did not undergo hydrolysis to phenyl-2-pyridylmethanamine but instead a ring-closure condensation with the formation of 1-phenyl-2,3a-diazaindene occurred.

Microfilm \$2.00; Xerox \$3.60. 64 pages.

#### THE STRUCTURE OF NEOBIOSAMINE C

(L. C. Card No. Mic 59-603)

Peter Wing Kee Woo, Ph.D.  
University of Illinois, 1958

Crude methyl neobiosaminide C, a methanolysis product of neomycin C, was carefully chromatographed over a charcoal column to give mixtures of isomeric methyl neobiosaminides C. Mild acid hydrolysis of these mixtures yielded the same neobiosamine C having mutarotation value of +104°, while vigorous acid hydrolysis yielded neosamine C, isolated as the dihydrochloride,  $C_8H_{14}N_2 \cdot O_4 \cdot 2HCl$ .

Analytical data for methyl  $\beta$ -neobiosaminide C, for crystalline methyl  $\beta$ -N,N'-di-(p-nitrobenzoyl)-neobiosaminide C, and for crystalline methyl  $\beta$ -N,N'-dibenzoylneobiosaminide C firmly establish the composition of neobiosamine C as  $C_{11}H_{22}N_2O_8$ , a disaccharide composed of a diaminoheptose and a pentose.

Mild acid hydrolysis of methyl N,N'-dibenzoylneobiosaminide C yielded ribose, identified by color tests and Rf values in various solvent systems. The rotation of the ribose, isolated from a preparative papergram, was negative, indicating that it is D-ribose. D-Ribose is therefore a component of neomycin C.

Methyl N,N'-dibenzoylneobiosaminide C reduced two moles of periodate; N,N'-dibenzoylneobiosaminol C, three moles. Bromine water oxidation of neobiosamine C yielded a crude product, whose infrared absorption was characteristic of a  $\gamma$ -lactone. Acid hydrolysis of N,N'-dibenzoylneobiosaminol C yielded ribitol but no ribose. These data indicate that neobiosamine C is 2-(neosaminido)-D-ribose.

Mild acid hydrolysis of methyl N,N'-dibenzoylneobiosa-



minide C followed by sodium borohydride reduction and subsequent selective N-benzoylation yielded N,N'-dibenzoylneosaminol C. This product selectively reduced two moles of periodate; the resulting N-benzoylserinaldehyde had a negative specific rotation in the reaction mixture, the same as that reported for N-benzoyl-L-serinaldehyde resulting from periodate oxidation of N-benzoyl-D-glucosaminol under identical conditions. Oxidation of the two-mole oxidation product with bromine water followed by acid hydrolysis yielded glycine and serine. Bromine water oxidation of the two-mole periodate oxidation product of methyl N,N'-dibenzoylneobiosaminide C and subsequent acid hydrolysis yielded glycine and isoserine, which were isolated, from a preparative papergram, as a mixture whose specific rotation was of the same sign (dextrorotatory) as that of D-isoserine. These data establish the structure of neosamine C as a 2,6-diamino-2,6-bisdeoxyaldohexose and also suggest that its C2 and C5 configurations are the same as those in D-glucosamine.

Evidence for the structure of neomycin C has been discussed.

Chromatography of neomycin B yielded mixtures of isomeric methyl neobiosaminides B, which were hydrolyzed to neobiosamine B having the same mutarotation value,  $+34^\circ$ . Analytical data for a purified sample of methyl neobiosaminide B establish the composition of neobiosamine B as  $C_{11}H_{22}N_2O_8$ , a disaccharide consisting of a diamino-hexose and a pentose. The isolation of a small amount of methyl D-ribose from the chromatography establishes D-ribose as a component of neomycin B.

Microfilm \$2.35; Xerox \$8.20. 177 pages.

## CHEMISTRY, PHYSICAL

### APPLICATION OF ORDER-DISORDER THEORY TO GAS ADSORPTION

(L. C. Card No. Mic 58-7963)

Stanley Bumble, Ph.D.  
Purdue University, 1958

Major Professor: J. M. Honig

The problem under consideration concerns the derivation of gas adsorption isotherms which take into account lateral interactions in the adsorbate. The adsorbent is considered as a two dimensional triangular lattice of sites, coverage to a monolayer being treated.

The method used is one based on a principle introduced by R. Kikuchi (Kikuchi, R., *Phys. Rev.*, **81**, 988 (1951)) and developed further by J. Hijmans and J. de Boer (Hijmans, J. and de Boer, J., *Physica*, **21**, 471, 485, 499 (1955)). This has led to a systematic approximation procedure. In each approximation, the lattice is decomposed into certain simple figures, and various possible modes of distribution of adsorbed particles among these figures are considered. The free energy of the system is shown to be a linear combination of the free energies of these simple units, when appropriate simplifying assumptions are introduced. At equilibrium, the chemical potential of the adsorbate is

set equal to the chemical potential of the gas phase. A resulting "equilibrium equation" relates the pressure of the gas to the amount of coverage of the adsorbate surface. Other equilibrium relations are also derived which do not contain the pressure explicitly.

The distribution numbers for the configurations of the different figures are interrelated by geometric consistency relations within the lattice, and by normalization requirements.

The set of all equilibrium, consistency, and normalizing relations lead to the elimination of all unnecessary variables and finally provide an equation which relates the gas pressure to the surface coverage only in terms of parameters containing interaction energies and temperature.

The first approximation, in which the lattice is considered as a collection of points, yields the Langmuir isotherm (Langmuir, I., *J. Am. Chem. Soc.*, **40**, 1361 (1918)). The second approximation, in which the lattice is represented as a superposition of points and "bonds," yields Fowler's more refined isotherm (Fowler, R. H. and Guggenheim, E. A., "Statistical Thermodynamics," The Macmillan Company, New York, 1939). Inclusion of the triangle configuration leads to a fourth degree polynomial in the variable K, which is dependent on gas pressure, p, and the fraction,  $\theta$ , of sites covered. Roots for this polynomial are obtained by use of a digital computer. Isotherms can be plotted for any value of the parameter  $C = \exp(-w/kT)$ , where w is the interaction energy between two nearest neighbor adsorbate particles. The calculations show that the isotherms for the triangle approximation differ appreciably from those of the bond approximation for values of  $-w/kT$  that are physically reasonable.

Finally, the rhombus is introduced in the procedure. On this basis it is possible to take account of next-nearest neighbor interactions. The algebraic difficulties require a new systematic approach to order-disorder problems. It is similar to the method used by Fosdick and James (Fosdick, L. D. and James, H. M., *Phys. Rev.* **91**, 1131 (1953)). Previously derived equilibrium conditions are given a quasi-chemical interpretation. A weight factor is assigned to the ratio of the distribution number for one particular occupied configuration to the distribution number for the completely unoccupied figure. This weight factor is analogous to the equilibrium constant for a "chemical reaction" by which an empty figure becomes occupied to a designated degree. The factor is approximated as a direct product of a limited number of unknowns, which can be set up by reference to pictorial representations. The problem is then simplified by mapping all the properties of the lattice onto one small figure in its different states of occupation. This results in a simple fourth degree polynomial in K.

The isotherm corresponding to this equation crosses the triangle approximation curve at  $\theta < 0.5$  and lies above this curve above the crossing point. In addition the slope through  $\theta = 0.5$  is smaller than the slope of the triangle approximation curve.

Calculations, for the bond and triangle approximations, indicate that the critical values of  $-w/kT_{cr}$ , at which two-dimensional condensation occurs, checks with previous results. The results of the rhombus approximation lie closer to the exact value of  $-w/kT_{cr}$  than the approximations previously used in the methods of lattice statistics.

Microfilm \$2.75; Xerox \$9.40. 210 pages.



INTERACTIONS IN THE SYSTEM  
ALUMINUM CHLORIDE-HYDROGEN  
CHLORIDE-DIETHYL ETHER

(L. C. Card No. Mic 59-293)

David Eugene Byrnes, Ph.D.  
Rensselaer Polytechnic Institute, 1958

Supervisor: Herbert M. Clark

The systems aluminum chloride-diethyl ether and aluminum chloride-hydrogen chloride-diethyl ether have been examined for component interaction and complex formation. Spectrophotometric, analytical, and conductometric techniques have been employed. The effect of water on these systems has also been studied and the question of solvent extraction considered.

Solute-solvent interaction in the aluminum chloride-diethyl ether system has been detected and the characteristic infrared absorption spectrum of aluminum chloride mono(diethyl)etherate,  $\text{AlCl}_3 \cdot \text{O}(\text{C}_2\text{H}_5)_2$ , has been obtained. A band appearing at  $10.1 \mu$  is associated with the covalent aluminum-oxygen bond. The conductometric behavior of ethereal aluminum chloride solutions indicates association of the current-carrying ions, a minimum in the molar conductance curve occurring at about 0.05 molar.

Introduction of moisture to ethereal aluminum chloride solutions brings about a decrease in specific conductance. The initial decrease is linear, but a sharp drop develops, with a point of inflection noticeable at a water-to-aluminum chloride ratio of about 1:6, coinciding with the appearance of opalescence. A minimum occurs at a ratio 1:3 to 1:4 followed by a maximum which coincides with appearance of a visible precipitate. The water adds to aluminum directly in a 6:1 ratio to form  $\text{AlCl}_3 \cdot 6\text{H}_2\text{O}$ . Excess water will cause the formation of two clear phases, aqueous and organic.

The compound  $\text{HAlCl}_4$  cannot exist as written; the presence of a "proton sink" is required in addition to the two expected constituents. Complex formation occurs in the ternary system aluminum chloride-hydrogen chloride-diethyl ether; the existence of the tetrahedral  $\text{AlCl}_4^-$  anion both in the compound  $\text{HAlCl}_4 \cdot 2(\text{C}_2\text{H}_5)_2\text{O}$  and in the concentrated ethereal aluminum chloride-hydrogen chloride solutions from which it crystallizes, has been demonstrated by Raman spectroscopic methods. Characteristic Raman spectra are presented in support of the postulated existence in these systems of the diethyloxonium ion,  $[(\text{C}_2\text{H}_5)_2\text{OH}]^+$ , and of the monodiethyl etherate thereof,  $[(\text{C}_2\text{H}_5)_2\text{OH} \cdots \text{O}(\text{C}_2\text{H}_5)_2]^+$ .

The quaternary system aluminum chloride-hydrogen chloride-diethyl ether-water does not function as a solvent extraction system, as do many of the analogous systems with other tri-positive metals. The anhydrous ternary aluminum system is similar to the corresponding systems with other metals in that the  $\text{M(III)}_4^-$  complex can form. However, the formation of this species in aqueous solution, or at least in the presence of water, is required for extraction. This is not possible in the aluminum system, as the hexahydrated aluminum is much more stable than either the anionic or neutral monoetherated forms, being formed in preference to either of these in the presence of even the slightest amount of moisture.

The following suggestion is made as to the rôle of water in solvent extraction. Lack of complete cationic

solvation in the aqueous phase is recognized as one of the prime movers responsible for extraction in systems of the type  $\text{M(III)}\text{X}_3\text{-HX-H}_2\text{O-R}_2\text{O}$ . The basic cation in both phases is the hydronium ion,  $\text{H}_3\text{O}^+$ . Through hydrogen bonding, this ion acquires three waters of solvation, forming the tri-hydrated hydronium ion,  $[\text{H}_3\text{O} \cdot 3\text{H}_2\text{O}]^+$ . This ion in turn has solvation requirements and as the concentration of "free water" becomes depleted in the aqueous phase the ion enters the organic phase in order to satisfy these requirements. Here ether molecules can participate in the "secondary" solvation, giving a mixed secondary solvation shell. Should the availability of water be decreased still further, a new ether phase forms, in which ether may participate in the "primary," as well as "secondary," solvation.

Microfilm \$2.60; Xerox \$9.00. 198 pages.

STUDIES AT HIGH TEMPERATURES:

- I. KINETICS OF OXIDATION AND NITRIDATION OF METALS: BARIUM, STRONTIUM, CALCIUM AND LITHIUM.
- II. HIGH TEMPERATURE CALORIMETRY: HEAT CAPACITY AND ENTHALPY OF SODIUM PEROXIDE.

(L. C. Card No. Mic 59-701)

Mallasetty Sondekoppa Chandrasekharaiah, Ph.D.  
The University of Wisconsin, 1959

Supervisor: Associate Professor John L. Margrave

I

Kinetics of oxidation and nitridation of barium, strontium, calcium and lithium have been studied as a function of time, temperature and pressure. A differential manometer technique has been employed with satisfactory results.

The rate of uptake of nitrogen gas by a piece of barium metal is very slow and nearly a linear function of time up to  $330^\circ\text{C}$ . Above this temperature, however, the linear rate is observed only until a surface film of about  $100 \mu\text{g}/\text{cm}^2$  is formed but then changed into an exponential time rate.

A similar behavior is observed in all other reactions studied except in the nitridation of strontium. Nitridation of strontium followed a simple linear rate until a temperature of  $350^\circ\text{C}$ . Above this temperature, the reaction started as a slow, linear rate, changed suddenly into a fast, exponential rate lasting for about 10 to 15 minutes and again changed into a linear rate.

Rate constants for the linear parts of the reactions are calculated from the slopes of  $\Delta m$  vs time plots and for the exponential rates from the slopes of  $\log \Delta m$  vs time plots, where  $\Delta m$  is the weight increase of the sample per unit area of the surface. From the variations in the rate constants with increases of temperature, apparent activation energies for these reactions are calculated.

- (i) For Ba- $\text{N}_2$  reactions

$300^\circ\text{C}$ . to  $420^\circ\text{C}$ .

$E(\text{linear rate}) = 17.2 \text{ kcal/mole}$

$E(\text{exponential}) = 5.9 \text{ kcal/mole}$



- (ii) For Sr-O<sub>2</sub> reactions  
120°C. to 180°C.  
 $E_{\text{(exponential)}} = 29 \text{ kcal/mole}$

For Sr-N<sub>2</sub> reactions  
300°C. to 400°C.  
 $E_{\text{(linear)}} = 28 \text{ kcal/mole}$

- (iii) For calcium-oxygen reactions  
330°C. to 475°C.  
 $E_{\text{(exponential)}} = 6.3 \text{ kcal/mole}$

- (iv) For lithium-nitrogen reactions  
140°C. to 300°C.  
 $E_{\text{(exponential)}} = 9.7 \text{ kcal/mole}$

In these cases with small activation energies for the exponential rates, an auto-catalytic reaction mechanism is tentatively proposed.

The influence of pressure of the gas on the rates of reaction is complex and erratic.

## II

Very little high temperature thermodynamic data for sodium peroxide are available in the literature. Hence, enthalpy differences for sodium peroxide at high temperatures were measured with a "drop" calorimeter technique. The sample was contained in a gold capsule, heated in a furnace to the desired temperature and dropped into a copper block type calorimeter. The rise in temperature of the calorimeter indicated the enthalpy difference of the sample between the temperature of the furnace and the final temperature of the calorimeter. The results are expressed by the following equations:

$$(H_T - H_{298.15}) = 16.7 T + 7.8 \times 10^{-3} T^2 - 5642 \text{ cal/mole}$$

$$C_p = 16.7 + 15.6 \times 10^{-3} T \text{ cal/mole/degree}$$

A transition point was observed at 500-510°C. with a heat of transition 1280 cal/mole.

Microfilm \$2.45; Xerox \$8.60. 187 pages.

### THERMAL REACTIONS OF HYDROCARBONS IN THE GAS PHASE

(L. C. Card No. Mic 59-296)

Michael A. De Crescente, Ph.D.  
Rensselaer Polytechnic Institute, 1958

Supervisor: George J. Janz

The research in this thesis has been concerned with the study of the thermal reaction of hydrocarbons at aromatization temperatures 300°-500° C., and at cracking temperatures, 600°-800° C. In the former case the gaseous addition of trifluoroacetonitrile to 1,3-dienes and the dimerization of butadiene, which is an example of a Diels-Alder cyclization reaction, were investigated. In the latter case a pyrolysis of triphenylmethane has been studied.

The addition of trifluoroacetonitrile to 1,3-dienes has been studied in the homogeneous gas phase in the temper-

ature range near 400° C. Using a continuous flow technique it was observed that the addition apparently proceeded to near equilibrium yields at reaction times of 35 min. In the case of butadiene, isoprene, 1,3-pentadiene the products were 2-trifluoromethylpyridine, 4-methyl-2-trifluoromethylpyridine and 6-methyl-2-trifluoromethylpyridine, respectively. The latter two pyridines are new compounds.

From theoretical considerations based on thermodynamics and kinetics, the conversions are predicted which would be expected if these processes operated under thermodynamic or kinetic control.

The addition of trifluoroacetonitrile to butadiene and the dimerization of butadiene to vinylcyclohexene have been studied in a constant volume system to obtain an experimental measure of the reaction equilibrium in each case. In the former, the results show qualitatively that equilibrium is approached but owing to the complex nature of the system a quantitative measure of the equilibrium could not be obtained. For the dimerization of butadiene an exact study of the reaction over the temperature range 330-420° C. has been possible. The heat of reaction and entropy changes for process are -37.8 kcal./mole and -17.8 e.u., respectively.

The dimerization of butadiene to vinylcyclohexene is an example of a Diels-Alder reaction in the gas phase. Comparison of the measured entropy of reaction with entropy of activation confirms that the activated complex in this process is cyclic rather than linear.

The gas phase pyrolysis of triphenylmethane has been investigated in the temperature range 650° C. to 750° C. using fast flow techniques. The only gas produced was hydrogen and complete cracking to C<sub>2</sub> hydrocarbons was not observed. A kinetic study of the evolution of hydrogen resulted in an energy of activation for the process, 83 kcal./mole. A mechanism comparable to the one which has been proposed for the pyrolysis of toluene accounts for all of the hydrogen resulting from the non-aromatic C-H bond split.

Triphenylmethane was found to decompose, forming hydrogen and benzene, at relatively low temperatures (645° C.) rendering it unsuitable for use in the carrier gas technique. Using 83 kcal./mole for the strength of the C-H bond and thermochemical data, a resonance energy for the triphenylmethyl radical was obtained,  $19 \pm 1 \text{ kcal./mole}$ .

Microfilm \$2.05; Xerox \$7.40. 156 pages.

### THERMODYNAMICS OF THE IONIZATION OF THE LYSYL RESIDUE OF INSULIN

(L. C. Card No. Mic 59-682)

Lise Gruen, Ph.D.  
Cornell University, 1958

Insulin has but a single lysyl residue in the monomer unit of molecular weight 6000. Hence it offers the opportunity of studying the properties of a single reactive group in a protein. The thermodynamics of the ionization of the ε-amino group of the lysyl residue of insulin have been studied in order to determine whether or not this group is



involved in an interaction with some other group in the protein. Since the location of the lysyl group in the insulin monomer is known from the Sanger sequence, such information would be of value in determining the spatial relationships of some of the groups in the molecule.

In order to separate the region of lysyl ionization from that of the four tyrosyl residues of the insulin monomer, the protein has been iodinated. All of the tyrosyl residues have been converted to diiodotyrosyls, with no other apparent modification of the protein. The ultraviolet absorption spectrum and spectrophotometric titration curves of the iodinated insulin are similar to those of 3,5-diiodotyrosine. In sedimentation and paper electrophoresis patterns the iodinated derivative shows a single peak. It contains the same end-groups as native insulin, as determined by DNP-analysis. The overall titration curve shows the expected difference from that of the native insulin in the region of phenolic hydroxyl ionization.

The thermodynamics of ionization of the lysyl residue were determined from titrations of solutions of iodinated insulin in 2 M KBr (to reduce electrostatic interactions) in the alkaline pH-range at four temperatures. The enthalpy of ionization was also determined from direct measurements of the change in pH with temperature of solutions of iodinated insulin in 2 M KBr and in 0.15 M KCl. By both methods the enthalpy of ionization of the lysyl residue in iodinated insulin was found to be between 12.7 and 13.7 kcal/mole.

For purposes of comparison, the thermodynamics of ionization of the amino groups of n-butylamine, alanyllysylalanine, and lysine have been studied by the same methods as were used for the protein. The apparent pK's observed for the lysyl group in iodinated insulin are in agreement with those found for the  $\epsilon$ -amino group in alanyllysylalanine if electrostatic interactions are taken into account. The enthalpy of ionization of the  $\epsilon$ -amino group in the protein agrees well with the values for the model compounds; the electrostatic factor has only a negligible effect on the enthalpy. Likewise the entropies calculated from the apparent pK's and enthalpies are the same, within the experimental error, for the lysyl group in iodinated insulin as for the amino groups of the model compounds.

If the lysyl group in the protein were involved as the donor in a hydrogen-bonding interaction with some other group, increases of approximately 5 kcal/mole in the enthalpy and approximately 18 e.u. in the entropy over the values observed in the model compounds would be expected. These changes in the thermodynamic constants are not at all in evidence. Thus, the  $\epsilon$ -amino group of the lysyl residue in iodinated insulin appears not to be involved in any strong inter-group interaction, but rather behaves thermodynamically as an essentially free group.

Microfilm \$2.00; Xerox \$7.00. 150 pages.

## TRANSFERENCE STUDIES ON ION BINDING IN POLYELECTROLYTE SOLUTIONS

(L. C. Card No. Mic 59-523)

William Brian Hill, Ph.D.  
University of Illinois, 1958

Hittorf-type transference experiments were carried out on solutions of polyacrylic acid partially neutralized with sodium hydroxide. The cell had platinum electrodes and was divided into two 50 ml. compartments by a coarse sintered glass frit. Sodium 22, a radioactive isotope of sodium, was added to the initial solutions so that concentration changes in the sodium could be calculated from radioactive counting rates. Conductance measurements were made on the solutions using an alternating current type of Wheatstone Bridge and solution pH's were determined with a Beckmann pH meter.

Utilizing these experimentally determined quantities, it was possible to calculate the fraction of the sodium ions in the solution which were bound to the polyacrylate ions. Techniques were standardized until values obtained for  $f$  (fraction sodium ions free) were reproducible to  $\pm .2\%$ .

The effect of quantity of electricity passed ( $N_e$ ) was investigated by making runs for different lengths of time at constant current. It was found that the value obtained for  $f$  increased monotonically with increasing passage of electricity. By plotting an appropriate function related to  $f$  versus  $N_e$ , a straight line, which could be extrapolated back to zero  $N_e$ , was obtained for each degree of neutralization. These lines did not, however, remain straight indefinitely, and the points at which they began to deviate were found to vary greatly with per cent neutralization.

At low per cent neutralizations, over half the acid in the cathode compartment could be transferred to the anode compartment before the plot deviated from a straight line. At 90% neutralization, only a very small per cent of the acid could be moved before these deviations appeared.

The point at which the line ceased to be straight coincided with the transfer of enough acid from the cathode compartment so that the concentration of sodium there exceeded that of the polymer. Naturally, the more highly neutralized the polymer was at the start of the electrolysis, the sooner an excess of sodium appeared in the cathode compartment. As long as the polymer was incompletely neutralized, the plot produced a straight line.

Through these considerations, a method was developed for eliminating the error introduced into ion binding values by the effect of quantity of electricity passed when calculated by the transference-conductance method.

Another portion of the research carried out involved an investigation of the effect of temperature changes on ion binding in sodium polyacrylate solutions; it was found that the dependence on temperature was small.

Microfilm \$2.00; Xerox \$3.60. 64 pages.



THE INFLUENCE OF PRESSURE  
ON THE HEATS OF VAPORIZATION  
OF SELECTED PURE LIQUIDS

(L. C. Card No. Mic 58-5148)

James Harvey Hobson, Ph.D.  
Emory University, 1953

An apparatus built and described by Vail has, after several modifications, been employed to make an extensive study of the heats of vaporization of several liquids. The modifications were for the dual purpose of correcting low values of the heats of vaporization which Vail had obtained, and of simplifying the mechanics of the operation. These changes effected considerable saving of time. The apparatus is capable of making direct determinations of the data necessary to calculate the heats of vaporization between the pressures of 825 and 140 millimeters of mercury. This variation of pressure produces decided changes in the boiling point and the heat of vaporization of the liquid being studied.

It seemed desirable to compare the results of this research with published data, and for this purpose benzene and n-heptane were studied. This comparison showed conclusively that the results of the measurements by this method are reliable.

To show the behavior of the apparatus over the entire pressure range, a study of the heat of vaporization of iso-octane was conducted. This study not only proved the possibility of measurements over the pressure range but also gave very definite evidence of the fact that there is a transition in the liquid state for iso-octane at about 63°C. It had been previously suggested on the basis of density data that such a transition might occur.

The heats of vaporization of the isomers, cis and trans-dichloroethylene, were studied at such pressures that the boiling points of the two were in the same range. It was shown that the heat and entropy of vaporization of these two isomers differ considerably when the boiling points of the two are the same.

The method here described is shown to have great possibilities for application to the study of the heats of vaporization of liquids over a wide pressure range. It is also suggested that such data will lead to better understanding of the liquid state. Not before has it been possible with so great ease to obtain as complete and as accurate data for the heats of vaporization.

Microfilm \$2.00; Xerox \$3.00. 47 pages.

CARBON ISOTOPE EFFECTS: MALONIC  
ACID DECARBOXYLATION

(L. C. Card No. Mic 59-526)

Richard Masayoshi Ikeda, Ph.D.  
University of Illinois, 1958

The inter- and intramolecular C<sup>13</sup> isotope effects associated with the decarboxylation of malonic acid and its monoanion in dioxane solution were investigated. The isotope effects and their temperature dependence were determined for the reactions and the results compared to the corresponding measurements made using a quinoline

solvent. These data were found to lend themselves quite readily to postulations of rapid equilibrium reactions occurring prior to the rate determining step of the decarboxylation. The abnormally high temperature dependence of the intramolecular isotope effect observed in the decomposition of the free acid in quinoline was again observed in the dioxane solution.

Theoretical considerations involving large models and complex reaction coordinates were applied to the decarboxylation reactions. As expressed in linear combinations of internal coordinates, the reaction coordinates gave flexibility to the computations and their effects definitely noticed in the values of the temperature independent factor. Numerous computations failed to give satisfactory results for the free acid decarboxylation, as expected. For the monoanion reactions, good agreement with experimental results was obtained using an eight-atom planar model and crude, but reasonable, molecular parameters and reaction coordinates. The agreement of the calculations here, is attributed to the "normal" character of these isotope effects. These are thought to be evidence of the fact that the negative charge of the decomposing molecule tends to lessen the liquid interactions and the model approaches physical reality. Further, in so doing, the system is thought to become more compatible with the gas phase assumptions of the computations.

The Bigeleisen-Wolfsberg-Slater treatment of the temperature independent factor of the kinetic isotope effect was extended to four-atom systems. Application of these considerations were made to the hydrogen-iodine reaction and also the acid hydrolysis of urea. In the former case, considerations of the reaction coordinate motion as assumed by early workers gave satisfactory results. For the acid hydrolysis of urea, the results of several configurational types were applied and agreement with experiment was obtained for the intramolecular hydrogen transfer mechanism as proposed by Shaw and Bordeaux.

Microfilm \$2.00; Xerox \$5.60. 115 pages.

A STUDY OF FACTORS INFLUENCING THE  
INTERFACIAL TENSION BETWEEN HEPTANE  
AND SOLUTIONS OF LIPOPROTEINS

(L. C. Card No. Mic 59-528)

Laylin Knox James, Jr., Ph.D.  
University of Illinois, 1958

The surface activities of ultracentrifugally isolated low-density lipoproteins from human blood serum and from hen's egg yolk have been investigated at the interface between heptane and aqueous solution. The lowering of interfacial tension by the adsorption and surface denaturation of these complex colloidal particles was found to be very time dependent. Measurements were made at 20° using a multiple pendant drop apparatus.

The surface activity and aging rate of human and egg yolk lipoprotein increased with concentration and the initial rate of fall of tension was approximately a linear function of concentration. Typically, the interfacial tension of an 0.018% solution of human lipoprotein fell from a value of 32 dynes/cm at 1 min. of age to 11 dynes/cm at 7 min.; subsequent changes were small in magnitude except with some systems where minima were found.



Lowering the pH (the range studied was 12-3) increased the surface activity of lipoprotein solutions. Storage at 4° for 5 days decreased the activity of the egg yolk material while the human material showed no decrease after as long as a week. Presaturation of lipoprotein solutions with heptane, depending upon the length of the saturation period and the procedure employed, either slowed the interfacial aging or else resulted in a partial loss of surface activity. Partial (prior) degradation of lipoprotein slowed interfacial aging and addition of sodium oleate to the  $S_f$  3-8 fraction of human lipoprotein, which previously aged relatively slowly, increased the aging rate.

It was found that isolated human lipoprotein was much more surface active than serum which had been diluted to the same concentration, based on total protein content. A characteristic faster aging was observed for solutions of human serum lipoproteins which contained more than 4% of the  $S_f$  10-20 species than was found for solutions containing only the  $S_f$  3-8 species.) However, solutions containing a preponderance of very low density lipoprotein ( $S_f > 20$ ) did not appear to show this rapid aging. The possible relationship of the aging behavior of the  $S_f$  classes to their stability and to the development of arterial lipid deposits is discussed.

A mechanism has been proposed to explain the interfacial aging of lipoprotein systems. In brief, it is suggested that the initial rapid fall of tension with time (this takes place during about the first 10 min. of aging for 0.018% human lipoprotein solutions) is due to a diffusion-controlled adsorption of native lipoprotein particles at the interface. The initial adsorption produces a monolayer of lipoprotein particles in which the protein-like character of the exterior surface of the particles predominates and an interfacial tension of about 25 dynes/cm is found. However, the particles are distorted, opened up, and fragmented due to the surface forces and the released lipids can, under the proper conditions, penetrate the protein-like film already present and form a mixed film which further lowers the energy of the system and results in an interfacial tension of about 10 dynes/cm. In the later stages of aging, elastic multilayers or membranes can be formed at the interface which lead to an immobilization of the interface and to questionable values for the boundary tensions.

Attempts to directly correlate interfacial aging behavior with clinical histories of human blood donors were not conclusive--only a small number of samples were studied.

Microfilm \$2.00; Xerox \$4.80. 91 pages.

#### STATIC ELECTRIFICATION OF FILAMENTS

(L. C. Card No. Mic 58-7858)

Joseph Bruno Levy, Ph.D.  
Princeton University, 1958

A study of the generation of charge on fibrous materials was carried out using an apparatus in which a fiber is held fixed in an insulated lower yoke while a second in a grounded upper yoke is rubbed across it under controlled ambient and mechanical conditions. The original apparatus was modified in two ways. The major modification allowed the measurement of the frictional work of rubbing during any rub. This was done by using a Linear Variable

Differential Transformer assembly to measure the deflection of the polystyrene beam which supported the lower yoke. By means of calibration curves it was possible to translate the reading observed on a vacuum tube voltmeter into units of energy. The minor modification was made to allow the complete discharging of both fibers used by means of a radioactive source.

It was found that, at any one velocity, a large number of rubs (several thousand) were required before values of charge transferred and frictional work of rubbing were obtained, which would remain constant over many more rubs. This fact was explained by the "stick-slip" motion of the fibers as they rub one on the other.

It was also found that the velocity of rubbing affected strongly both the charge transferred and the frictional work of rubbing, the former being found to decrease and the latter to increase with increasing velocity. This was explained in terms of local heating, plastic junctions and material transfer which occur during rubbing. An empirical relationship relating the velocity of rub, the frictional work of rubbing and the charge transferred was found to hold in the great majority of the cases examined.

From the experimental data obtained it was possible to calculate the mechanical energy put into any one rub and to estimate the electrical energy obtained from the same rub. Thus for any pair of fibers under a given set of conditions it was possible to calculate the efficiency of the process of converting mechanical energy to triboelectrical energy. Under certain experimental conditions efficiencies of the order of 2.0% were found.

It was shown that, in some cases, part of the triboelectrically generated charge on a fiber resided within the volume of the fiber and could not be removed by exposure to alpha particles alone - penetrating gamma or beta radiations were necessary.

The presence of mineral oil on the fiber surfaces during rubbing was found in most cases to cause a decrease in both the charge and frictional work of rubbing.

Certain polyacrylonitrile-cellulose acetate polymer blend fibers were found to have surfaces which were such as to cause reversals in the sign of charge transferred on repeated rubbing.

Under certain conditions, the charge on a fiber was found to decay in an abnormal manner.

Photographs were taken to show that material transfer takes place when fibers are rubbed many times.

Microfilm \$2.00; Xerox \$5.40. 108 pages.

#### AN ELECTROKINETIC STUDY OF THE SOLID-LIQUID INTERFACE

(L. C. Card No. Mic 59-881)

Armand Francis Lewis, Ph.D.  
Lehigh University, 1958

This dissertation is concerned with the investigation of the role of streaming potential in studying the solid-liquid interface. A review of the fundamental nature of electrical double layers is presented, followed by a discussion of electrokinetic effects in general.

An experimental study is made of the variables involved in the generation of streaming potentials. Studies



of isocyanate sponge and quartz wool diaphragms at various compressions reveal that potential is highly dependent on permeability. This fact is not considered in the classical streaming potential equation of Helmholtz which is used widely in the literature. This discrepancy is corrected in part by combining the classical Kozeny-Carmen equation for flow through porous media with the Helmholtz equation. The resulting equation describes streaming effects in terms of streaming current and flow rate as well as dimensions of the plug. Correlations are best for intermediate permeabilities; deviations are still apparent for highly compressed diaphragms.

Streaming potential, conductivity, and viscosity all are sensitive to temperature variations. Empirical relations are noted between reciprocal temperature and the logarithms of certain pressure induced,  $\Delta P$ , properties of the material, notably the flow rate,  $Q$ , the streaming potential,  $E_s$ , and the streaming current,  $I_s$ .

Temperature studies enable two new approaches to be made regarding the electrical characteristics of interfaces. One approach is thermodynamic and treats streaming potentials in terms of ionic adsorption; the other is kinetic and considers streaming as a rate process.

The streaming potential term  $\Delta P/E_s$  has the fundamental units of charge per unit volume, and is identified with the charge density of electrokinetically active ions in the double layer. This parameter is named the electrokinetic charge density. By measuring the electrokinetic charge density in various ionic strength solutions and at several temperatures, a differential heat term is calculated (named isocoulombic heat). For quartz wool interfaces, this heat value ranges from 1.3 to 4.4 kcal/mole.

Isocoulombic heats depend upon both the type of electrolyte and the temperature. They correlate well with the sedimentation behavior (sediment heights) of quartz powder in the same electrolytes and at the same respective temperatures. Hence isocoulombic heats appear to be a direct measure of a thermodynamic property of the already wetted surface.

The streaming current term  $I_s/Q$  also represents a charge per unit volume. The logarithm of this parameter is linearly related to reciprocal temperature as are  $\log \Delta P/Q$  and  $\log I_s/\Delta P$ . The slopes permit energies to be calculated for various physical changes which occur on streaming; for example  $\Delta P/Q$  gives an energy,  $\Delta E_f^*$ , which is identical with the known values for the energy of viscous flow;  $I_s/\Delta P$  results in a relation,  $\Delta E_k^*$ , which when combined with  $\Delta E_f^*$  gives an energy for streaming,  $\Delta E_s^*$ . This value is -0.3 kcal/mole for the quartz wool-water system.

Both of these new approaches to interpreting the streaming potential effect give insight into the mechanism of emf generation in a streaming cell. The magnitudes of the heat terms imply that two physical processes (adsorption and hydration) are involved, and that the energy for streaming is the difference between the two. In addition, the concepts of charge density and energy for streaming enable electrokinetic data to be interpreted without the use of the controversial zeta potential.

Microfilm \$2.75; Xerox \$9.60. 211 pages.

## A MODEL FOR CONFIGURATIONAL CHANGES IN POLYPEPTIDES AND PROTEINS

(L. C. Card No. Mic 58-7876)

Leonard Peller, Ph.D.  
Princeton University, 1958

The primary step in the denaturation of proteins probably involves the rupture of intramolecular hydrogen bonds with an accompanying unfolding of helices. A model is presented to examine such configurational changes in proteins and synthetic polypeptides in solution. The model, which consists of an infinitely long single chain of amino acid residues, can exist in two extreme forms - an ordered helix maintained by peptide-peptide hydrogen bonds and a disordered polymeric random chain. The equilibrium state of the system, consisting of alternating helical and random chain regions, is intermediate between these two forms.

Following Hill's work, an Ising-like partition function is used to describe the configurational state of the system. The equilibrium configuration of the model is derived by finding those values of the variables (the number of statistical units in the helical form and the number of junctions between helical and random chain regions) which correspond to the maximum term in the partition function.

The equilibrium state depends on two parameters. One parameter ( $j_c/j_h$ ) can be related to the heat of severance of a peptide-peptide hydrogen bond and the entropy of rotation of a random chain residue. The second parameter ( $y_{hc}$ ) essentially determines the likelihood that neighboring units will be in different configurational states. Plausible values for these parameters in aqueous media are suggested.

The treatment predicts a transformation from a helix to a random chain in water as the temperature is raised. The transition temperature ( $T_t$ ), where half of the residues are in the helical form and half are in the random chain form, depends only on  $j_c/j_h$ , whereas the sharpness of the transition depends chiefly on  $y_{hc}$ . For sufficiently small values of  $y_{hc}$  the transformation takes place in a narrow temperature range and approaches a phase transition in character.

The above treatment is contrasted with Schellman's discussion of the helix-random chain equilibrium which ignores all intermediate states. The effects of certain implicit approximations employed in the present treatment are examined.

The interaction of small molecules with the polypeptide is considered, especially the binding of urea to the NH and CO groups formed by rupture of internal hydrogen bonds. For a value of the binding constant suggested by urea dimerization data, the polypeptide is converted from a helix to a random chain as the activity of the bound molecule in solution is increased. The presence of the bound molecule normally depresses  $T_t$ , but under some conditions it may bring about a reversal of the usual temperature behavior, resulting in the helix being the stable form at higher temperatures.

Electrostatic effects are treated for polypeptides containing carboxyl groups. The electrostatic free energy and the titration equation of both a charged helix and a charged random chain are determined by the usual methods of polyelectrolyte theory. Owing to the possibility of



chain expansion, the free energy of the latter is much less dependent on the total charge than that of the former.

The variation of the configurational state of the model with pH is examined quantitatively (employing certain approximations). Increasing the pH causes the helix to be transformed to a random chain. The sharpness of the transition depends largely on  $y_{hc}$ . The transition is accompanied by a liberation of protons. The relation of this ionization to certain phenomena observed in protein denaturation is discussed.

Some speculations are presented concerning the possible role of phase-like transitions in proteins involved in biological processes.

Microfilm \$2.00; Xerox \$6.60. 136 pages.

#### HINDERED ROTATION STUDIES AND STRUCTURAL DETERMINATIONS BY NUCLEAR MAGNETIC RESONANCE TECHNIQUES

(L. C. Card No. Mic 59-281)

Lawrence Hector Piette, Ph.D.  
Stanford University, 1958

Rotational isomerization is established in the alkyl nitrites from their proton magnetic resonance spectra at low temperatures. A development of the Bloch equations indicates that the change in line width of the proton resonances, as a function of temperature, will yield values of the potential energy barrier to rotation for the nitrites. A temperature dependent study on the nitrites was carried out from +25°C to -75°C. Barriers of 6-10 k. calories were obtained for methyl, ethyl, n-propyl and isopropyl nitrite. A comparison of the resonance energy difference of the two forms of nitrite with the barrier measurements indicates there is a considerable amount of double bond character in the O-N bond.

A complete analysis of the proton resonance spectrum of formamide is achieved by making selective isotopic substitutions into the molecule and by applying the double resonance technique to eliminate smearing by the quadrupole interactions of the  $N_{14}$  nucleus. The analysis indicates that formamide exists predominantly in one form only with a considerable amount of double bond character in the C-N bond.

The  $N_{14}$  magnetic resonances of a host of nitrogen compounds were obtained. Correlations between the line width and the symmetry about the  $N_{14}$  nucleus were made.

Microfilm \$2.00; Xerox \$5.20. 104 pages.

#### MICROWAVE MEASUREMENTS OF DIELECTRIC RELAXATION

(L. C. Card No. Mic 58-7879)

Donald A. Pitt, Ph.D.  
Princeton University, 1958

The dielectric relaxation times of some larger molecules and an apparatus for the measurement of dielectric properties at lower microwave frequencies are discussed

in this dissertation. The solutes investigated are molecules of ellipsoidal symmetry having the dipole moment on a principal axis, and show a variety of molecular sizes and shapes. The quantitative applicability of current theories of dielectric relaxation is evaluated by means of the experimental results.

A resonant coaxial cavity measuring system is presented which is operable over a wide frequency range and is especially applicable to measurements on dilute solutions of polar compounds in non-polar solvents. The cavity lengths in successive modes of resonance determine the real part of the dielectric constant. Dielectric loss is related to the power transmission through the cavity near resonances. The equations pertinent to the operation of the cavity are developed through equivalent circuits and transmission-line theory. The measurement technique, including the use of a phase reference signal for the interferometric determination of wavelengths in lossy media, is described.

The dielectric constants of benzene solutions of anthrone, fluorenone, and phenanthrenequinone have been measured at 1.25, 3.22, 10.0, 25.0, and 50.0 cm. wavelengths at temperatures of 20°, 40°, and 60°. The relaxation time and its distribution parameter for each solute have been determined from arc plots of the slopes at each wavelength for the dependence of dielectric constant and loss upon the concentration of the solute. Anthrone and fluorenone have values of relaxation time which would be anticipated from their molecular sizes and shapes. The value for phenanthrenequinone is anomalously high, perhaps due to a greater volume swept out by this molecule in orienting about its long axis.

The dipole moment and dielectric relaxation time of acepleiadylene, measured in dilute benzene solution at 30°, are  $\mu = 0.49 \times 10^{-18}$  esu - cm. and  $\tau = 20.7 \times 10^{-12}$  sec., respectively. The moment is half the value predicted by quantum mechanical calculations. Possible reasons are discussed. The relaxation time is comparable to those of other aromatic compounds of similar size.

The dielectric relaxation times of cupric heptaphenylchlorophenylporphyrine and of ferric chloro-octaphenylporphyrine have been determined in benzene solutions, based on dielectric constant data at five wavelengths and three temperatures. The dipole moment of the cupric complex lies in the molecular plane, while that of the ferric complex is perpendicular thereto. The relaxation time of the copper compound is close to that calculated by equations taking into account the microscopic viscosity. The ferric complex, with a relaxation time 5/2 that of the cupric complex, is better described by a relation involving the macroscopic solvent viscosity. It is evident that relaxation occurs through two different modes of orientation.

The viscosities of dilute solutions of seven polar solutes in two non-polar solvents have been measured at 20°, 40°, and 60° and the slopes of the viscosity-concentration plot evaluated. An approximate form of the mutual viscosity equation of Hill allowed calculation of the solution dielectric relaxation times, which were higher by a factor of 2 to 4 than the experimental values. Two solutes showed higher correlation factors. The approximate equation for mutual viscosity shows satisfactory agreement with a more exact method of calculation, based on binary liquid system data from the literature and measured in this laboratory. Literature data on phenol systems yield a value of 4-5 cp. for pure phenol by extrapolation from dilute



solution viscosities, which may constitute a viscosity corresponding to the absence of association.

Tables are provided which cover relaxation data reported by Chemical Abstracts through the end of 1956, listing relaxation times, distribution parameters, thermodynamic data, and temperature dependence.

Microfilm \$3.90; Xerox \$13.20. 303 pages.

# NUCLEAR SPIN RESONANCE IN FOUR-PROTON SYSTEMS

(L. C. Card No. Mic 59-1298)

William Bernard Schwabacher, Ph.D.  
University of Minnesota, 1958

The magnetic resonance spectrum of the ring protons of paradisubstituted benzenes was calculated and compared with experiment. The effect upon the spectrum of the internal chemical shift and four spin-spin coupling constants was calculated for the  $A_2B_2$  case by the method of McConnell, McLean, and Reilly (1). Experiments at 30 Mc yield a value of the chemical shift  $\delta$  as large as 44 cy/sec and the largest of the spin-spin coupling constants, ortho,  $J_O$ , averaging 8.9 cy/sec for over 20 compounds. Closer examination of the spectra leads to values of the meta coupling constants,  $J_{AA}$  and  $J_{BB}$ , and the para constant  $J_P$ . Internal chemical shifts are found to depend on the solvent used and its concentration. The solvent dimethyl sulfoxide affects the internal as well as the overall shift much more than does cyclohexane.

Solution of the four-proton  $A_2B_2$  problem with 16 spin functions involves the eigenvalue determination of a 16 by 16 Hamiltonian matrix. When factored, the largest block is of 4 by 4 size. The spectrum is obtained from the positions and intensities of the 28 transitions between the 16 eigenvalues. Much of this is similar to the work of Pople, Schneider, and Bernstein (2). The present calculation was also programmed for a Remington Rand UNIVAC Scientific 1103 Computer, so that inserting the parameters ( $\delta$ ,  $J_O$ ,  $J_P$ ,  $J_{AA}$ ,  $J_{BB}$ ) leads to a spectrum in about a minute. Calculated spectra presented bracket expected values of the parameters for the p-disubstituted benzenes, and the variation of spectrum with each of the parameters over a wider range is indicated on graphs. Zero values of  $J_P$ ,  $J_{AA}$ , and  $J_{BB}$  correspond to the AB case. Near this limit, appropriate for p- $C_6H_4XY$ , the typical quartet of an AB spectrum, with J equal to the ortho constant  $J_O$ , has added satellites due to meta coupling across the ring. The quartet lines are also split by the para coupling  $J_P$ . If the outermost satellites are large, it is an indication of coincidence due to other lines shifted by a relatively large  $J_P$  (of about 0.5 cy/sec). Calculated spectra of p-chlorobenzonitrile ( $\delta$ , 9, 0.5, 2.3, 2.3) and p-chlorophenyl isocyanate ( $\delta$ , 9.1, 0.5, 2.6, 2.6) are matched with experimental ones at 40 and 60 Mc.

## REFERENCES

1. McConnell, McLean, and Reilly, J. Chem. Phys. **23**, 1152 (1955).
2. Pople, Schneider, and Bernstein, Can. J. Chem. **35**, 1060 (1957). Microfilm \$3.50; Xerox \$12.20. 273 pages.

# PART I: THE PRINCIPLE OF MINIMUM BENDING OF ORBITALS. PART II: IRREVERSIBLE THERMODYNAMICS AND RATE THEORY. PART III: CHROMATOGRAPHY AND FLOW CHARACTERISTICS.

(L. C. Card No. Mic 58-7956)

George Hudson Stewart, Ph.D.  
University of Utah, 1958

Chairman: Henry Eyring

## I

A principle of valence, the principle of minimum bending of orbitals, has been developed as a model for understanding molecular and electronic conformations of ground and excited states. The quantum mechanical basis of the principle has been elucidated. A survey of applications has been made and the following examples of its use have been discussed: rotational barriers, strain theory, trans effect, stereo-directed reactions, bond angles, acid-base character.

The values of the principle lies in its wide scope and its simplicity of application to the correlation of seemingly unrelated effects. It should prove a valuable aid in predicting and understanding conformations.

## II

A general formulation of irreversible thermodynamics has been made from absolute rate theory pointing out the assumptions contained in the reduction to classical form. To a first approximation, the reciprocal relation of Onsager was found to be explicit in the rate equation. A generalization to higher order systems has been accomplished.

Non-isothermal systems have been considered and methods of treatment have been proposed. These considerations have been extended to excited states and diabatic reactions with a classification of reaction types.

## III

The use of the mathematics of diffusion for the description of flow of the mobile phase in a chromatogram has been proposed. The diffusion equation has been experimentally tested for the flow of various solvents in chromatographic paper of various geometries. The diffusion analogy was found to predict the equation of flow and the concentration profiles within the reproducibility of experiment, justifying the use of the diffusion analogy.

The use of the diffusion equation has been shown to be readily adaptable to the analysis of pore models. The non-uniform pore model analyzed provides a useful model for understanding the mechanism of flow and requires only the postulate of an additional resistance factor due to tortuosity of the paths to yield agreement between the model and experiment.

Microfilm \$2.00; Xerox \$5.80. 117 pages.



# AN APPARATUS FOR MEASURING HEATS OF VAPORIZATION IN CONTROLLED ATMOSPHERES

(L. C. Card No. Mic 58-5185)

Charles Brooks Vail, Ph.D.  
Emory University, 1951

An apparatus for the measurement of heats of vaporization which had previously been developed in this laboratory was modified and installed in a large tank by means of which the atmosphere and its pressure could be controlled. The institution of regulated pressures greatly extended the applicability of the device, which incorporates photoelectric timing, contact of the sample with glass and platinum only, and the opportunity for any number of reruns without opening the apparatus. The method employed is a direct approach wherein the energy quantities and weight of sample may be obtained simultaneously, and in most cases no correction need be applied except for the buoyancy effect upon the analytical balance.

Operation of the apparatus is achieved by remote controls and the measurements are considered virtually free from the human error. The precision of the measurements was shown to be very good, with the average deviation being regularly less than 0.1%. Within the period of a single day a compound may be studied at one atmosphere and at any desired reduced pressure. The accessible pressure range extends from about 40 millimeters to above 760 millimeters of mercury.

A critical discussion of the method was presented and two appendices were attached which treat summarily the calculation of the second virial coefficient from heats of vaporization and the relation of heats of vaporization to free volume. Microfilm \$2.00; Xerox \$4.20. 80 pages.

# A KINETIC STUDY OF THE OXIDATION OF RARE EARTH METALS, SOLUBILITY OF RARE EARTH METALS IN THEIR NITRIDES, AND INFRA-RED STUDIES ON SOME RARE EARTH COMPOUNDS

(L. C. Card No. Mic 58-5870)

Karl Spyros Vorres, Ph.D.  
State University of Iowa, 1958

Chairman: Associate Professor LeRoy Eyring

The kinetics of the oxidation of lanthanum, cerium, praseodymium, neodymium, samarium, gadolinium and ytterbium have been studied. All of these follow a parabolic oxidation law, although the results for ytterbium are ambiguous. Cerium shows a transition to a linear law after an initial parabolic portion.

The rate of reaction decreases in the order cerium, praseodymium, neodymium, lanthanum, gadolinium, samarium or ytterbium. Cerium and praseodymium form oxide layers with at least two oxides.

Loriers mechanism for the oxidation of cerium did not fit these data. Coherence of the dioxide is assumed to give a protective coating, giving the parabolic law.

The rates and data reproducibility were affected by annealing of the metal and oxide, previous treatment and

thermal history of the sample, and the passage of argon over the sample. The effects tend to disappear at high temperatures where bulk diffusion is most important.

Oxygen diffusion through the oxide seems to be the mechanism involved in all of the reactions, with a possible exception for samarium.

The rates are most rapid in the case of single oxide coatings for the elements with the highest oxide volume ratios.

A new approach to the rapid determination of rate constants by use of a continuous temperature increase method was developed and used.

Separate studies on the solubility of rare earth metals in their nitrides were made. When the metals were dissolved in their nitrides a decrease in the lattice constant of LaN and NdN was observed.

Infra red data were obtained on several solid rare earth compounds. The data on hydrolyzed solid oxides showed the presence of characteristic OH bands.

Microfilm \$2.05; Xerox \$7.40. 156 pages.

# OBSERVATIONS ON MOLECULAR EFFUSION. IV

(L. C. Card No. Mic 59-594)

Phillip Glenn Wahlbeck, Ph.D.  
University of Illinois, 1958

Cadmium atoms were allowed to effuse into a vacuum through a glass orifice which had the shape of a right circular cylinder. The diameter of the orifice was 0.2426 mm, and the length was 0.3230 mm. The effusion vessel containing the cadmium was heated by a mercury vapor bath. The mercury vapor bath temperature was regulated by the pressure of an inert atmosphere above the boiling mercury. The temperature of the effusion vessel was measured by a calibrated chromel-alumel thermocouple. The molecules were allowed to strike the detector, a condensation target. The target was a very flat quartz disk which was cooled with liquid nitrogen. The target plate was suspended parallel to the orifice at a distance of approximately one centimeter above the orifice. The profile of the effusate was studied by an interferometric method using a Fabry-Perot multiple beam interferometer. A shutter was used to allow control of the period during which the effusate was collected.

In this research, the prime interest was in the study of the angular distribution of the effusing molecules at varying pressures of cadmium vapor behind the orifice. By angular distribution one means the number of molecules which effuse in a direction making angle  $\theta$  with the normal to the plane of the orifice and passing through solid angle  $d\omega$ . A secondary interest was in the measurement of the total effusate.

P. Clausen<sup>1</sup> has published a theory for the angular distribution of molecules effusing from an orifice whose shape is that of a right circular cylinder. Clausen assumed that the mean free path of the cadmium atoms is large (molecular flow condition) and that molecules which strike the wall of the orifice are restituted in a random manner obeying the cosine law of restitution. One aim of the present investigation was to test the Clausen theory. The theory was found to be inadequate to account for the



observations. The observed intensity of molecules effusing in the forward direction was larger than the theory predicted. No explanation for the deviation from the theory was proposed.

Another aim of the research was to study what happened to the angular distribution when the mean free path is decreased. The results were discussed in terms of the Knudsen number, the ratio of mean free path to orifice diameter. It is believed that when the Knudsen number is larger than ten, one has molecular flow. In this research, the Knudsen number varied between 0.29 and 32.9. It was found that when the Knudsen number decreased, the intensity of effusing molecules in the forward direction decreased with an increase in the intensity in the peripheral directions. As the Knudsen number decreases, more gas-phase collisions occur in the orifice. A semi-empirical theory was proposed to account for gas-phase collisions in the orifice.

In this research, the measurement of total effusate was only indirect and subject to large experimental error. It is questionable if anything can be said about the total number of effusing molecules.

An analysis of experimental error was made. It led one to the conclusion that the inherent error of the condensation target was large. At small angles (forward direction) it is highly probable that all molecules which strike the target condense on the target. At large angles it is more probable that only a small fraction of the molecules which strike the target condense on the target.

Microfilm \$2.65; Xerox \$9.20. 201 pages.

1. Clausing, P., *Verslag. Gewone Vergader. Afdel. Natuurke. Koninkl. Ned. Akad. Wetenschap.*, **35**, 1023 (1926).

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#### CALORIMETRIC INVESTIGATION OF RESIN-PLASTICIZER INTERACTIONS

(L. C. Card No. Mic 59-884)

Robert E. Walck, Jr., Ph.D.  
Lehigh University, 1958

The enthalpy changes on dissolving resins in plasticizers are of interest from a theoretical and practical viewpoint. The rate of solution of the resins into the plasticizers is too slow and the viscosity of the resulting solutions is too high to allow direct calorimetric measurement of the heat of solution.

An indirect method for determining the heats of solution of resins in plasticizers was developed. This method, based on Hess's Law involves the determination of the heats of solution of mixed and unmixed resin-plasticizer combinations of equal concentrations into the same reference solvent. The difference in these heat values is the heat of solution of the resin into the plasticizer. Intrinsic viscosities were also determined on several of the systems.

A low molecular weight coumarone-indene resin and two of its molecular weight fractions were investigated. The plasticizers used in this study were dialkyl phthalates,

dialkyl sebacates, an alkyl and aryl phosphate and a diester of N, N-bis (2-Hydroxyethyl)-2-Ethylhexanamide.

The heats of solution do not follow the predictions of the Scatchard-Hildebrand equation for the heat of mixing of nonelectrolytes. The heats of solution were primarily dependent on the size and shape of the plasticizer except where chemical interactions are possible. The interactions are directly proportional to the molecular weight of the resins. A maximum interaction was observed for the unfractionated resin and both fractions when mixed with the phthalate plasticizers. The maximum occurred with the di-n-butyl homologue in each case. Tricresyl phosphate, di-n-hexyl phthalate and Flexol 8N8 also exhibited high interactions with the unfractionated resin. Only the phthalate plasticizers were used with the resin fractions. Intrinsic viscosities showed qualitative agreement with the calorimetric results although no maximum was observed in the unfractionated resin-phthalate systems. The fractions were not investigated for intrinsic viscosity.

Microfilm \$2.00; Xerox \$3.80. 68 pages.

#### AMINE ABSORPTION AND ELUTION STUDIES USING CATION EXCHANGERS

(L. C. Card No. Mic 59-815)

Stanley Read Watkins, Ph.D.  
University of Colorado, 1958

Supervisor: Professor Harold F. Walton

The absorption of uncharged amines from both aqueous and non-aqueous solvents by sulfonated polystyrene resins was investigated. The affinity of the resin for different amine salts in various solvents was studied by a column elution method.

The aromatic amines--aniline, benzylamine, and pyridine--as well as n-butylamine and piperidine were used for the absorption studies in water, glacial acetic acid, methyl alcohol, and dioxane solvents. The amine absorbed by the resin was calculated from the difference in the concentration of the solution before and after shaking an amine solution with a weighed amount of resin.

Absorption of amines from aqueous solutions by the hydrogen form of the resin takes place in two steps. The amine that diffuses into the resin phase is quickly neutralized forming the amine salt which is held as the counter ion. When the exchange capacity is reached, the uncharged amine diffuses through the swollen resin, as long as it satisfies steric requirements, and becomes absorbed on the resin framework itself. This non-ionic binding of the organic molecule by the resin is attributed to van der Waals attractive forces and is observed particularly with aromatic compounds. The non-ionic absorption above the exchange capacity of the resin for aniline and benzylamine follows the Freundlich equation. There is non-ionic absorption to a decreasing degree for pyridine, n-butylamine, and piperidine. Resins with lower percentage of divinylbenzene cross-linking show a greater non-ionic absorption. Aniline absorbed on the sodium, magnesium, and calcium forms of the resin varied with the particular salt used as the counter ion. Absorption of aniline on the magnesium form was as high as one third the exchange



capacity. Similar studies with aniline and methacrylic acid resins showed no non-ionic absorption. Column absorption studies showed a non-ionic absorption of aniline by the resin above the capacity of the resin. The excess of aniline was easily stripped off with methyl alcohol. This behavior was not observed with pyridine. It is concluded that, although the physical attraction between the aromatic groups in the amine and the resin is the determining influence on the degree of absorption, other important factors are related to the ease with which the amine can diffuse up to a point closer to the resin framework where the short range van der Waals forces become effective.

The behavior of ion-exchange resins in non-aqueous solutions is different from that in aqueous solutions with respect to the degree of absorption and to the swelling accompanying absorption. Absorption of aniline and benzylamine from solutions of acetic acid and dioxane by the hydrogen form of the resin was less than the exchange capacity, and was unusual in dioxane solutions in that, as the concentration of the amine in the solution increased, the amount of amine absorbed decreased. This decreased absorption was accompanied by decreased swelling of the resin. This critical relationship between the relative volume of the resins and the degree of absorption is influenced by the water content of the resin. Pyridine and n-butylamine showed no unusual behavior and were absorbed by the resin until the exchange capacity had been reached.

The column elution of amine salts with acids in aqueous and non-aqueous solvents was studied with the purpose of predicting feasible separations. The degree of separation of two solutes during an elution with acid depends upon the relative speed with which they move down the column. The effect of the polarity of the solvent on the elution curve was related to the changing solubility of the amines and ionization of the eluting acid. Successful separation of aniline from pyridine was predicted from the elution curves. Microfilm \$2.00; Xerox \$5.00. 98 pages.

#### APPLICATIONS OF STARK EFFECT MODULATION TO MICROWAVE SPECTROSCOPY

(L. C. Card No. Mic 58-5191)

William Stilwell Wilcox, Ph.D.  
Emory University, 1952

A microwave spectrograph employing the principle of Stark effect modulation has been constructed. This spectrograph makes it possible to study the rotational absorption spectra of gaseous substances in the frequency range of about 22,000 to 40,000 megacycles per second. The gas pressure required for the study of spectra is usually of the order of 100 microns, but may be much less or considerably greater in some instances.

The Stark effect spectrograph is more sensitive than the direct absorption cell, and studies of the Stark effect make possible the determination of molecular dipole moments and facilitate the identification of spectral lines. The operation of the spectrograph is described in detail.

The microwave spectrum of vinyl cyanide was observed and analyzed. This molecule is a slightly asymmetric top for which the five  $J = 2 \rightarrow 3$  rotational absorption lines fall in the readily accessible frequency range of approximately

27,000 to 29,000 mc/sec. These five lines were identified and their frequencies were measured.

The rotational constants and moments of inertia of vinyl cyanide were calculated from the observed spectrum. The constants  $a$ ,  $b$ , and  $c$  were found to be 49,076.2, 4971.33, and 4514.05 mc/sec respectively. The values obtained for the moments show the molecule to be planar.

The direction and magnitude of the dipole moment of vinyl cyanide were computed from data obtained by a quantitative study of the Stark effect for two of the absorption lines. The values of the dipole moment and its components along the axes of smallest and intermediate moments of inertia were found to be:  $\mu = 3.89$  D,  $\mu_a = 3.68$ , and  $\mu_b = 1.25$ . The direction of the moment was found to be, within the experimental error, parallel to the  $C \equiv N$  bond.

The hyperfine structure of two of the vinyl cyanide lines was partially resolved in the direct absorption spectrograph. From the observed separations of the hyperfine components, the quadrupole coupling constant in the direction of the axis of smallest moment of inertia was calculated. Its value was found to be -3.0 mc/sec.

The microwave spectrum of pyrrole was studied, and more than 80 lines were observed.

By observation of the relative intensities of certain pairs of Q-type lines in the pyrrole spectrum, it was shown that the entire molecule, including the N-H bond, is coplanar.

Some lines in the pyrrole spectrum with values of  $J$  up to 20 were identified by a graphical method.

A study of the Stark effect for two observed  $J = 1 \rightarrow 2$  lines of pyrrole showed that the dipole moment of the molecule must lie in the axis of smallest moment of inertia.

Some notes are given on the use of various published material in the analysis of pure rotational spectra of asymmetric top molecules.

A few suggestions are made with regard to future work that might prove to be of interest.

Microfilm \$2.00; Xerox \$5.20. 103 pages.

#### THEORY AND CHARACTERISTICS OF A VOLTAMMETRIC MERCURY MEMBRANE ELECTRODE

(L. C. Card No. Mic 59-233)

Arthur Moberg Wilson, Ph.D.  
Northwestern University, 1958

Supervisor: Richard C. Bowers

A new voltammetric electrode is described. A thin, 3 to 4 mil, cellophane film is attached to a pyrex tube. A mercury pool is placed on top of the film to provide the surface at which electrode reactions may be studied. The film serves as a rigid aqueous matrix through which ionic and non-ionic species may diffuse.

A linear finite diffusion model is assumed to hold for this electrode. Theoretical equations, describing the current dependence on physical parameters, for both the steady state and the transient conditions, are derived for the boundary conditions pertaining, using Fick's second law. Integration of Fick's second law for the transient conditions is accomplished using a Laplace transform method.



The validity of the steady state equation is tested explicitly with thallous and cadmium ions. The transient equations are found to be valid for thallous ions at all concentrations studied, but with cadmium ions only at  $10^{-4}$  M. and higher concentrations. This deviation from theory is explained on the basis of an adsorption mechanism.

A "homogeneous" model is adopted for the membrane matrix due to the measurement of an effective area for diffusion equivalent to 100% of the cross-sectional area of the pyrex tube. This model is substantiated by temperature studies on the limiting currents.

The theory of current-voltage relationships is developed for three model electrode couples; hydroquinone-quinone, thallous-thallium amalgam and nickelous-nickel amalgam. The hydroquinone-quinone couple is found to behave in an irreversible fashion in contrast to literature data. The thallous-thallium amalgam electrode is found to be reversible as predicted and good correlation between literature and experimental  $E_{1/2}$ 's are observed. The nickelous-nickel amalgam couple is irreversible as predicted. The simple theoretical use of the Tafel equation does not seem to adequately explain the electrode kinetics. The complication of the electrode kinetics is ascribed to the adsorption phenomena.

Microfilm \$2.00; Xerox \$4.00. 73 pages.

#### THE NATURAL RADIOACTIVITY OF RHENIUM

(L. C. Card No. Mic 58-5559)

Clarence John Wolf, Ph.D.  
Purdue University, 1957

Major Professor: W. H. Johnston

The present thesis describes results on low-level internal gas Geiger counting and proportional counter spectroscopy on the interesting nuclide Rhenium-187 and reports a half-life of  $1.40 \pm 0.22 \times 10^{11}$  years and a maximum beta energy of  $3.3 \pm 1$  Kev.

The rhenium was introduced into the counters as rhenium oxychloride prepared by a new and more direct procedure. This method involved the reduction of rhenium (VII) oxide with dioxane to rhenium (VI) oxide and chlorination with elemental chlorine at  $175^\circ\text{C}$  in a combustion tube. The vapor pressure of the oxychloride is  $4.5 \pm 0.5$  mm of mercury at room temperature (about  $22^\circ\text{C}$ ); the gas density is  $6.5 \times 10^{-5}$  g/ml; and the gaseous infrared spectrum showed a strong absorption peak at 10.3 microns.

A stainless steel and a nickel counter were used for the experimental measurements as they were found to be unreactive toward the oxychloride. The rhenium oxychloride with a large amount of neon and one of the following three quench gases was found to be quite acceptable for counting purposes; one part of chlorine to four parts of argon, dibromodichloromethane, and dichlorotetrafluoroethane.

Twenty-five separate determinations of the half-life were made using internal gas low-level counting techniques. In

these determinations the counter, total pressure, partial pressure of the rhenium oxychloride, and quench gases were varied. The half-life was found to be  $1.40 \times 10^{11}$  years with a standard deviation of  $0.22 \times 10^{11}$  years. The gas efficiency of the counters was considerably less than 100 percent; it ranged from 4.5 percent to 85 percent. External Cobalt-60 and Iron-55 standard sources were used to determine the gas efficiency of the oxychloride containing counters. These sources were standardized in both counters using a gas which was well known to be 100 percent efficient. The sample counting rate itself was also used to determine the efficiency. This latter procedure assumes a constant meson background counting rate. In a few cases the efficiency was determined by the addition of a known specific activity of Argon-37 to the counting gas. The gas efficiency was found to be independent of the energy of the ionizing event, this will not in general be true. The efficiency effect introduces considerable error in the measurements since it seems to be equivalent to a reduction in the effective counter volume.

The proportional counter spectrometer consisted of the stainless steel counter, a preamplifier, a high gain non-overloading linear amplifier, and a Radiation Instrument and Development Laboratory 100-channel memory core pulse height analyzer.

The beta decay spectrum was shown to yield a linear allowed and first forbidden unique Kurie plots although several rough approximations were made. The maximum beta energy is  $3.3 \pm 1$  Kev. The rather large uncertainty in the energy arises from the low gas efficiency of the counter. The spectrum shows a large deficiency of beta particles with a kinetic energy less than 1-Kev.

The energy of rearrangement of the atomic electrons as rhenium changes to osmium is about 13.5-Kev. Since this large energy difference does not appear in the spectrum, it is probable that a bare rhenium nucleus would be stable with respect to beta minus decay and actually it is a rhenium atom which decays into an osmium atom.

Microfilm \$2.00; Xerox \$6.20. 128 pages.

#### THE STRUCTURE OF $\psi$ -CONHYDRINE

(L. C. Card No. Mic 59-1309)

Hideyasu Steve Yanai, Ph.D.  
University of Minnesota, 1958

The three-dimensional structure, except for the absolute configuration, of  $\psi$ -conhydrine has been determined in an X-ray diffraction study of  $\psi$ -conhydrine hydrobromide. In agreement with recent chemical evidence, the OH and propyl groups are found to be trans to each other, and in the equatorial position relative to the saturated six-membered ring. The unit cell is orthorhombic in the space group  $D_2^2-P2_12_12_1$ , contains four  $\text{C}_8\text{H}_{18}\text{NOBr}$ , and has dimensions  $a = 15.15$ ,  $b = 9.28$ ,  $c = 7.72$  Å. Refinement, including anisotropic thermal motion, has yielded values of  $R = \sum ||F_o| - |F_c|| / \sum |F_o| = 0.109$  and  $r = \sum w(|F_o|^2 - |F_c|^2)^2 / \sum w|F_o|^4 = 0.056$  for the 920 observed reflections.

Microfilm \$2.00; Xerox \$3.00. 35 pages.



## ECONOMICS

### ECONOMICS, GENERAL

#### CHANGING CONCEPTS OF THE LARGE FIRM AND ANTITRUST ENFORCEMENT

(L. C. Card No. Mic 58-7815)

William Lee Baldwin, Ph.D.  
Princeton University, 1958

This dissertation is basically a review of the literature on the large firm, with primary emphasis on evaluation of the relevance of this literature to antitrust enforcement and its use by the enforcement agencies and the courts. The general conclusions are that the literature contains a wealth of insights which could be extremely useful both in formulating and implementing antitrust policy; that these insights can be integrated into a reasonable, internally consistent concept of the large firm and its role in modern industrial society; but that the legislators, courts, and enforcement agencies have made only slight use of such economic analysis.

The review of the literature distinguishes two major lines of development: first, the work done within the framework of classical economics, partial equilibrium theory, the assumption of profits-maximizing behavior, and an orientation towards consumer welfare as the proper goal of economic activity; and second, more recent work which is concerned with economic goals other than consumer satisfaction and which rejects traditional economic analysis either as incorrect or irrelevant to the major problems. The first line of work is found to have developed from an unnecessary concern over the naturalness of the trust movement, engendered by faith in *laissez-faire*, into a body of literature with ever-increasing realism in its assumptions and relevance to the study of industrial concentration. The second line of work is considered valuable in directing attention to goals of economic activity such as research and development, improved working conditions and national defense, and in emphasizing the importance of the organization rather than the individual entrepreneur.

Critics of economic theory who hold it to be erroneous, rather than irrelevant, are mostly writers not trained in economics, and these criticisms appear to be based on misconceptions of the economists' use of static theory and the assumption of profits maximization. A synthesis of the two lines of thought is proposed. Chester Barnard's definition of the formal organization is modified so as to pertain to the concept of the business organization derived from this synthesis. The business organization is defined as "a system of consciously coordinated activities or forces of two or more persons in which the system is designed to orient the activities or forces towards the maximization of its own profits." This definition is tested by an empirical study of the Du Pont organization and is found to be valid and useful, although profits maximization appears as the overwhelmingly predominant rather than sole goal.

The influence of economics on the development of the nation's antitrust policy is traced and is found to have been

slight. This is attributed both to non-economic objectives of the policy and to the failure of economists to use available analysis in advising the policy makers and enforcement agencies. Failure to use the insights of previous writers is also found in current literature on both antitrust enforcement and the nature of the large firm.

It is concluded that, to make the greatest use of their extremely valuable concepts in selecting areas for antitrust attack and in formulating legal remedies, economists must recognize the non-economic factors underlying the antitrust philosophy, must define the goals that they expect their recommendations to achieve, and must broaden the concepts of monopoly and competition beyond the control of market price, to include such areas as research. Arguments for big business based on national defense contributions are regarded as invalid, and arguments based on the effects of potential competition through the threat of entry are held to be exaggerated. But a potent defense for market monopoly may be made if it is necessary to support competition in other areas.

Microfilm \$3.30; Xerox \$11.20. 253 pages.

#### INDUSTRIAL, REGIONAL, AND COUNTY PATTERNS OF UNION ORGANIZATION IN THE POST WORLD WAR II PERIOD: A TEST OF GENERALIZATIONS

(L. C. Card No. Mic 59-685)

John Wallace Leonard, Ph.D.  
Cornell University, 1958

The purpose of this study is to test the accuracy of the following generalizations with heretofore untried data and method:

1. Since the end of World War II, labor has failed to organize to any significant degree the workers in the trade and service industries.
2. Since the end of World War II, labor has failed to organize to any significant degree the workers in the South.
3. Since the end of World War II, labor has failed to organize to any significant degree the workers in the small cities.

Records of the National Labor Relations Board provide the number of employees in bargaining units certified by the Board in organizational elections only, for each year during the period, 1948-1956. These are the data which, in this study, are substituted for union membership figures as a measure of union organization. When taken as a percentage of increments to employment volume, these certified employee data represent an approximate index of the proportion of organization. In turn, this index is used as a measure of the significance of postwar union organization in the trade and service industries, the South, and



small counties (the data necessitated the use of small counties rather than small cities). The principal means of determining the degree of significance of such organization is comparison with a similar index respectively for the goods industries, the regions of the North Central, Northeast, and the West, and the metropolitan areas and large counties. In addition, the percentage of organizational elections won by unions and the percentage of total valid votes cast for unions in organizational elections won by unions are used to supplement the fundamental data.

On the basis of these data and this method, it is determined that the trade and service industry generalization is totally accurate. Beyond this, there is definite evidence that union organization is not even keeping pace with the general and gradual increase in employment volume in these industries.

If the southern generalization is taken precisely as stated, it must be adjudged accurate. Furthermore, the saturationists' assumption of greater resistance to union organization in the South than in any other region is verified by the study. However, while this is true, it is also true that unions have been even less productive in the West than in the South during the postwar period. In addition, a number of industrial southern states deviate considerably from the regional pattern in the South. To supplement the regional locational factor in union organization, a strong inverse relationship between rate of employment volume growth and proportion of union organization by state is developed. This relationship is partially explained by similar inverse relationships of less magnitude between percentage of total employment in the trade and service industries and proportion of union organization and also between rate of increase in the number of firms in operation and proportion of union organization.

The small-city generalization appears to be totally inaccurate. During the period, 1949-1953, labor unions evidently were quite successful in organizing the workers in the small cities. Again, however, the saturationists' assumption of greater resistance to organization in the small cities appears to be accurate. The saturationists appear to have misjudged only the unions' ability to overcome this resistance. Microfilm \$3.20; Xerox \$10.80. 245 pages.

# AN ANALYSIS OF THE TEACHING OF CERTAIN ECONOMIC TOPICS IN THE CALIFORNIA PUBLIC JUNIOR COLLEGES

(L. C. Card No. Mic 59-868)

John Howard Linn, Ed.D.  
University of Southern California, 1958

Chairman: Professor Finn

The purpose of this study was to compare the extent to which certain economic topics were taught in the beginning economics (Economics 1a) and beginning business (Introduction to Business) classes at the junior college level. It was further hoped that a relationship could be ascertained between class success and the personal characteristics of the teachers or the teaching techniques used by them.

The causal-comparative method of research was used. Eighteen classes in business and eighteen classes in

economics, from seven junior colleges and one state college, were tested for their knowledge of certain economic topics. The test that was created was designed to illustrate the forty-seven topics declared to be "indispensable for those who would be economically literate" by the Council for the Advancement of Secondary Education in their report entitled Key Understandings in Economics. The same eighty-item test was given to the students at the beginning and at the end of the semester.

Each of the twenty-one participating teachers contributed data concerning certain personal characteristics, teaching methods used during the semester, and how many of the forty-seven "indispensable" topics they intended to teach. These data were analyzed and the analysis of the variance between the mean scores of the several groups was made.

**Findings.** (1) Eleven hundred and seventy-eight students scored a mean of 35.69 on the initial test. Since a mean of 20 could be obtained by guesswork (1 out of 4), it indicates that beginning college students knew only 16 answers out of 80. (2) The economics students scored better than the business students at each taking of the test and scored larger mean gains. The difference was significant far beyond the 1 per cent level. (3) Fifteen class sections of economics completed both tests. One section failed to make a significant gain. Of the eighteen business class sections, four failed to make a significant gain, and six others made gains significant only at the 5 per cent level. (4) Men scored significantly better than women at each age level. (5) Age was a factor in the ability to score. The "below 20" group scored a mean of 34.23, while the "over 30" group scored 42.24. (6) Students who had not taken economics in high school scored significantly better than those who had. (7) Other than the traditional lecture-discussion method of teaching, so few examples of additional teaching techniques were reported that no relationship between techniques and class success could be drawn.

**Conclusions.** (1) Courses or units of economics, taken in high school, were ineffective. (2) Sex and age were decisive factors in the ability to score well on the topics test. (3) Economics teachers did a better job of teaching the topics than did the business teachers. However, the gain in score points was surprisingly small. The gain in mean score points was only 6.87. (4) Size of class bore little relationship to class success. (5) The teachers of the participating classes taught by the lecture-discussion method. So few additional aids or techniques were reported that their use could be said to be nonexistent.

**Recommendations.** (1) High school economics courses should be carefully studied. Further study should determine if the teachers are adequately prepared. (2) More effective classroom materials and techniques of presenting them should be developed for this area. (3) The amount of topical information given within the classes should be increased. (4) Teacher-training institutions should make certain that prospective business and economics teachers are well qualified in both educational techniques and business economics.

Microfilm \$2.60; Xerox \$9.00. 200 pages.



# AGRICULTURAL STAGNATION AS AN OBSTACLE TO INDUSTRIAL GROWTH IN INDIA, 1920-1950

(L. C. Card No. Mic 58-7867)

Orlando Joseph Menezes, Ph.D.  
Princeton University, 1958

The apparently phenomenal wartime growth in industrial production was found to have been actually disappointing, because it largely represented a displacement of imported manufactures, with total consumption of manufactures remaining practically stagnant. The problem thus became one of explaining this stagnation. The interwar and postwar periods were also examined for comparison. Agricultural stagnation was advanced as the major explanation of retarded industrial growth during all three periods.

Chapter I is a theoretical discussion of how stagnant agriculture retards industry. First, the market for industrial products in the important agricultural sector remains limited. Second, with a stagnant food supply, the price of manufactures must decline relative to food prices to induce consumers to accept the increased relative supply of manufactures. Third, industrial wages are largely determined by food prices. But an expansion of industrial production is only profitable if prices of manufactures rise relative to industrial wages. Hence the conditions required to encourage increased consumption and increased production of manufactures are inconsistent.

Chapter II measured the increase in industrial production during the war and postwar periods. Mass consumption of manufactures, notably of textiles, failed to increase significantly. Consumption increases were noted only for luxury articles or articles whose demand was affected by non-economic growth factors. Over the interwar period--after allowing for a recovery in textile consumption as textile prices receded from abnormally high levels following the first world war--mass consumption also seemed to have stagnated.

Chapter III measured agricultural production and the food supply, showing that they were stagnant throughout the interwar period; and that they increased little, if at all, during the war and postwar periods.

Chapter IV indicated that an increase in real income tends to raise expenditure on food as well as on manufactures; and produced factual evidence that consumption of manufactures during all three periods changed when and only when there was an opposite change in prices of manufactures relative to food prices.

Chapter V showed that agricultural stagnation tends to retard industrial growth even when the supply of labour and capital are favourable. It was shown that there is a large and increasing rural labour surplus. But secular trends in real wages indicated that this labour is available to industry only at a real wage fixed in relation to food prices. In Chapter V it was noted that high profit rates and high price/wage ratios were associated with growth industries. It was also noted that inflation greatly increased the supply of funds for investment, but failed to stimulate industrial investment--again presumably because the rate of return on such investment is not attractive in an economy suffering from agricultural stagnation.

Chapter VI measured the very large inflationary stimulus during the war due to deficit spending by the Indian government and a surplus in the balance of payments--the latter largely due to military expenditures in India by

the U.K. government. But this inflationary spending failed to stimulate a significant increase in the real rate of consumption in general, or consumption of manufactures in particular. This again was ascribed to the stagnation of the food supply, because of which deficit spending merely led to a rise in food prices and hence in industrial wages and prices. Microfilm \$2.15; Xerox \$7.60. 164 pages.

# RISE AND DECLINE OF THE CALIFORNIA APPLE INDUSTRY

(L. C. Card No. Mic 59-280)

David Robert Papera, Ph.D.  
Stanford University, 1958

This study traces the growth and development of the California apple industry from its early beginning in the middle 19th century to the middle of the 20th century. Interwoven with this historical description is an analysis of the economic forces and reactions that have molded and shaped the California apple industry. Apples were the first fruit crop of commercial importance in early California and California continues to be a leading center of United States apple production. This case study illustrates the difficulties encountered by producers of tree crops in adjusting to changing economic forces and records in detail the manner in which California apple producers have met these problems. The long time lag between investment decisions and the time at which they come to fruition makes the adjustment problems of tree crop producers especially interesting.

After treating the broad aspects of national and international apple developments the study describes the origin of the California apple industry and examines its current structure. The remainder of the study is devoted to disentangling the various forces that have affected the supply and demand of California apples and to analyzing responses of producers to changing economic conditions. In the broadest context, the forces affecting both the supply and demand for California apples describe and explain the history of the industry.

Noteworthy results of the study were found in the investigation and analysis of producer responses to price incentives. It is generally thought that the long-run supply of tree crops is responsive to price incentives but that short-run production is relatively inelastic because of the lag between the time of planting and the time of bearing. It is also commonly argued that both long-run and short-run supply are rather insensitive to falling prices and demand because of the heavy orchard investment that the tree-crop producer holds by the time his orchard reaches the bearing stage. California apple producers demonstrated considerable short-run and long-run supply sensitivity to decreasing prices. Both apple acreage and apple production declined in California during the period of low prices and profits that prevailed in the 1930's. Not only were new plantings curtailed, but some bearing acreage was actually removed. In addition, California producers cut production in the short run in response to low prices by decreasing the intensity of their cultural practices to the point where yields dropped sharply.

The difference in apple-marketing techniques that



developed between the two main apple-producing centers in California was another interesting reaction to changing economic conditions pointed up by the study. Changes in marketing organization brought about by changes in the supply-demand situation were found to bring about further changes in demand. The comparison of marketing methods in the two main producing centers suggested that cooperative marketing was less effective than an atomistic form of marketing in meeting adverse competitive factors.

Throughout their history, California apple producers have indicated through their supply responses, choice of apple varieties planted, and the location of their enterprises a marked sensitivity to the stimuli of the free market. While they miscalculated expected profits, partly because they could not foresee decisive technological changes, they adapted their business management to the changing conditions. The free market from coast to coast has been a strong force which has stimulated the growth of the California apple industry and has brought about the adjustment required by continuous economic change.

Microfilm \$2.70; Xerox \$9.20. 205 pages.

#### THE BROILER CHICKEN INDUSTRY - AN ECONOMIC STUDY

(L. C. Card No. Mic 59-282)

James Tyree Ralph, Ph.D.  
Stanford University, 1958

The commercial broiler chicken industry has attracted much attention in the years since World War II from students of agriculture and economics. By offering more chicken at lower prices to the housewife, it has changed chicken meat from an occasional luxury food to an everyday dish that has made inroads into the market for pork if not the market for beef. This phenomenon of greatly increased production in spite of continued lower prices, the tendency toward concentration of production in limited areas and the unusual type of financing justify an economic study of this entire industry.

The purpose of this study was to gain an understanding of the overall organization and functioning of this industry in order to answer such questions as: Why did it grow as it did? Who was mainly responsible for its rapid growth? What motivated many agriculturalists to enter this new industry? How was it possible to offer greater quantities of chicken meat at lower prices? What new lessons in agricultural organization and business functioning may be learned from the broiler industry? What effects may this have on other agricultural industries?

Information for this study was obtained by a review of the literature on the subject and by interviews with persons concerned with the industry.

It was found that per capita consumption of broiler meat has steadily risen since 1934 from about .5 pound to over 16.0 pounds in 1956. Since 1956, production of broilers has been increasing faster than the population. At the same time consumption of farm-produced chicken meat declined from almost 13.0 pounds to just over 7.4 pounds. The net gain in total chicken-meat consumption was almost as much as the gain in beef or red meat consumption and much higher in percentage term. Most of this happened due to lower prices.

The production of broiler chickens differs from other agriculture in that a far greater percentage of the factors of production are purchased from off the farm, and the ratio of variable costs to fixed costs is much higher. The general tendency in agriculture to maintain production when prices of farm products decline is often explained by the high proportion of fixed costs. The broiler industry with its typically low percentage of fixed costs not only has maintained but increased production substantially while prices declined.

The increase in broiler chicken production was made possible by progress in several areas. First, research on disease control made possible production in large flocks without fear of catastrophic loss. Mortality as high as 25 to 40 per cent was common in 1925, but today only a very poor producer ever has losses as high as 5 per cent. Research in breeding has produced crosses and strains of birds which are far more efficient in converting vegetable feeds into meat protein than before and research in nutrition has produced feeds which allow the farmer to secure weight gains at a much lower feed cost per pound than before.

New technical developments made the growth of the broiler chicken industry possible; but new business arrangements and practices brought it about. Hatcheries, feed manufacturers and dealers, and poultry meat processors extended credit to producers just as suppliers and buyers had done for many years in other agricultural industries. When credit proved insufficient to spur continued increases in production, creditors assumed the risk of production such that today over 95 per cent of the broiler chickens produced in the United States are produced under some type of contract between the producer and a supplier or buyer which reduces or practically does away with the risk to the producer. By doing this, these financiers or contractors have been chiefly responsible for the growth of the broiler chicken industry.

Most of the farmers who entered broiler production did so due to the unattractiveness of alternative opportunities in their area. On the Delmarva Peninsula fishing and vegetable farming were becoming less attractive as a source of income and employment. In northwest Arkansas a once thriving apple industry had declined. In North Carolina farmers with small acreages were finding it increasingly difficult to earn a living income with tobacco and cotton. In Kentucky and Tennessee the tobacco acreage allotments were becoming smaller and in the Georgia, Alabama, Mississippi and Texas broiler areas cotton was an insufficient source of income for the farmer with a small acreage. In California many people looked upon broilers as a means of earning an income from a small acreage while enjoying the benefits of rural life.

Due to both technical progress and more efficient organization of the industry, the real money cost of supplying consumers with broiler chicken meat is actually lower than it was in the 1930's. Many middlemen such as jobbers, brokers and commission merchants have been eliminated in marketing of broiler chickens. The influence of contract farming in bringing about this lowering of the total costs of production may suggest to suppliers, producers and buyers in other agricultural industries how some of their problems may be solved. Such problems as seasonality, volume fluctuation, uniformity and quality control, and the high cost of assembling from distant producers which are faced by many processors and distributors of meats and vegetables might be more easily solved through the form



of contracting or vertical integration that has developed in the broiler chicken industry. This method may have special appeal to some cooperatives or private corporations because it does not entail government assistance.

Microfilm \$4.10; Xerox \$13.80. 318 pages.

**SOME ECONOMIC AND FINANCIAL IMPLICATIONS  
OF THE 1950-1958 AMENDMENTS TO THE FEDERAL  
OLD-AGE SURVIVORS INSURANCE PROGRAM**

(L. C. Card No. Mic 59-565)

Robert Lee Randolph, Ph.D.  
University of Illinois, 1958

The Federal Old-Age and Survivor's Insurance System, or OASI, is a social insurance system created under the Social Security Act of 1935. This program, which covers approximately nine out of ten employed persons, provides certain income protection against the problems created by death and old age. The benefits received by eligible beneficiaries are financed by a tax on the worker and, with the exception of the self-employed, his employer. The funds collected are appropriated to the Federal Old-Age and Survivor's Insurance Trust Fund. That part of the fund which is not needed to pay benefits and administrative costs is invested in interest-bearing United States Government Securities.

With the exception of the amendments of 1939, no major changes were made in this program until the 1950's when coverage and benefits were greatly expanded. These amendments have not only extended the basic protection afforded the individual worker and his family from income insecurity due to old-age, but they have caused aggregate contributions and benefits to reach such high levels in recent years that the program must now be considered as having important implications for the economy as a whole.

Besides a brief examination of the historical evolution of OASI, of the elements which distinguish the OASI approach from other public and private programs which are concerned with the same or similar risks, and of the differences between the present OASI financing provisions and alternative methods which have been proposed, the main attention is focused on gaining an estimate of the initial effect of the OASI program finances on consumption.

Under OASI financing, a portion of the flow of income is diverted--directly in the case of the employees contribution and indirectly either through lower wages or higher prices depending on whether the employer's contribution is shifted forward or backward--and transferred as benefit payments to other individuals or as additions to the OASI Trust Fund. The initial effect of the redistributive estimates computed by income class on consumption (saving) for a given year (1956) is estimated by making certain general assumptions regarding the impact of contributions and benefits on spending--i.e., the marginal propensities of contributors and beneficiaries to consume.

In conclusion, it is apparent that the income class distribution and consumption propensities differ in such a way that the program was only slightly deflationary in 1956. Most of the benefits are received by persons in the \$3000 and below income classes, whereas most contributions are ultimately paid by persons in income classes

above \$3000. In a year when OASI financial operations are in closer balance (aggregate contributions and benefits more nearly equal), we may expect that the net increase in consumption caused by income transfers from those who ultimately bear the burden of the contributions to beneficiaries will outweigh the net subtraction from consumption represented by that portion of OASI program receipts, if any, allocated to the OASI Trust Fund. Assuming high-employment conditions, the program is likely to be inflationary in the future. Adoption of either pay-as-you-go or level-premium financing will not lessen this tendency, and their effects will not be as anti-cyclical in a depression period as those of the financing method presently used. Microfilm \$2.00; Xerox \$6.60. 139 pages.

**ECONOMICS, AGRICULTURAL**

**ENTERPRISE SELECTION FOR THE  
ECONOMIC DEVELOPMENT OF PART-TIME  
FARMS IN WISCONSIN**

(L. C. Card No. Mic 59-704)

Diedrich Dyck, Ph.D.  
The University of Wisconsin, 1959

Supervisor: Associate Professor Sydney D. Staniforth

The Problem

Many farm families in the United States realize lower incomes than do nonfarm families possessing similar resources. Farm operators and family members often acquire nonfarm jobs to increase family income. These farm families must organize their farm operations to suit their off-farm work. This study investigates the opportunities for income improvement on part-time farms through the selection of new enterprises.

Method of Analysis

The linear programming technique is used to evaluate the relative profitabilities of selected possible enterprises on part-time farms. The enterprises are selected on the basis of the present organization and resources available on part-time farms in Price County, Wisconsin. This county is located in what has been designated as a low farm income area. The alternatives are two dairy and two poultry enterprises with different levels of productivity, dairy replacement, feeder calf, feeder pig and sheep enterprises. Profit maximizing plans are computed for five enterprise situations under each of three labor situations differing with respect to the amount of operator off-farm work. The enterprise situations are: (1) all livestock enterprises of average productivity with the purchase of grain allowed, (2) all livestock enterprises with no purchase of grain or forage, (3) all livestock enterprises except above average poultry and no purchase of grain or forage, (4) only above average dairy with purchases of both grain and forage, and (5) only average dairy with no purchases of grain or forage. The labor situations selected



for consideration in this study are: (1) where the operator works eight hours daily off the farm, (2) where the operator works six hours daily off the farm, (3) where the operator works eight hours daily off the farm from mid-October to mid-March.

### Results

In the three enterprise situations where livestock enterprises are allowed to compete for resources, the most profitable solution under each labor situation is one including feeder pigs as the major source of income, and forage consuming livestock to utilize the hay produced. Labor is the limiting resource. Second in the order of profitability is a program with poultry of above average productivity as a major income source and forage consuming livestock to utilize the home-grown forage. In this case the home-grown feed is limiting. The least profitable solution contains dairy cows of above average productivity and sheep, with home-grown feed the limiting resource.

Most part-time farmers in Price County presently rely upon dairy as the major farm enterprise. This study indicates that dairying is relatively unprofitable on these farms within a wide range of prices and regardless of whether or not livestock production is limited to the home-grown feed supply. It indicates further that little additional capital investment would be required for a shift to more profitable livestock combinations. Thus opportunities for income improvement exist on many part-time farms through more careful enterprise selection.

Microfilm \$2.30; Xerox \$8.00. 174 pages.

## ECONOMICS, COMMERCE — BUSINESS

### MARKETING IDEAS OF SELECTED EMPIRICAL LIBERAL ECONOMISTS 1870 TO 1900

(L. C. Card No. Mic 59-489)

Frank Gordon Coolsen, Ph.D.  
University of Illinois, 1958

This dissertation provides an analysis and appraisal of the marketing ideas that appeared in the writings of four late nineteenth century American economists. Three of the men selected--Edward Atkinson, David Ames Wells, and Arthur Farquhar--were business men who wrote widely on various economic subjects. The fourth economist, Henry Farquhar, was a government statistician. The marketing ideas taken from the various literary works of these men represented a consistent and, in some respects, comprehensive understanding of modern marketing and its effects upon the American economy. They maintained an unqualified faith in Economic Liberalism and applied the doctrines of *laissez faire* to marketing phenomena. They campaigned for the removal of protective tariffs and attempted through their popular writings to promote the adoption of "free trade" as a public policy. It was in connection with their effects to answer the "home market" arguments of the protectionists that they made significant empirical analyses of the revolutionary changes in market

conditions and marketing methods that occurred in the United States during the closing decades of the nineteenth century.

Edward Atkinson in his 1885 book, entitled *The Distribution of Products*, developed an estimate of the value of goods marketed in the United States by commodity lines. He analyzed the cost of marketing food products, made recommendations for the reduction of retailing costs, presented the results of several comprehensive market research studies, and demonstrated in various ways that he had a clear understanding of the meaning and importance of the marketing process. David Ames Wells, in his 1889 study of *Recent Economic Changes*, presented an astute analysis of the effects of revolutionary developments in physical distribution and in marketing methods upon the economic progress of the Nation. He explained the changes that had occurred in market conditions and their influence upon commodity prices and business cycle fluctuations. Wells expressed in this book some provocative ideas on the relationship between marketing and innovation and the dynamic factors affecting expansion of consumer demand. Arthur and Henry Farquhar included some significant ideas on the marketing of manufactured goods in their 1891 volume entitled *Economic and Industrial Delusions*. They developed and applied a number of unique and useful statistical methods for the measurement of market demand for agricultural products. The concepts and analyses included in these three volumes were representative of the status of marketing thought in the United States in the late nineteenth century. Marketing was not considered as a separate subject for scientific inquiry at that time, and marketing ideas were developed within the broad framework of discussion of contemporary economic problems.

An appraisal of the combined contributions to marketing thought by topics from the various writings of Edward Atkinson, David Ames Wells, Arthur Farquhar, and Henry Farquhar is included in this dissertation. Their ideas on agricultural marketings, the marketing of manufactured goods, international marketing, and physical distribution represented a comprehensive view of the scope and importance of marketing which compares favorably with that now current. They correctly predicted later changes in market conditions and marketing structure. Their approach to the study of marketing was empirical. They made a number of significant contributions to statistical methods of market analysis. Atkinson, Wells, and the Farquhars adopted a distinctive macro-economic view of the marketing process. They were primarily concerned with the aggregate effects of marketing phenomena upon national income and the total economy, rather than with the marketing activities and problems of the individual firm. Recent developments indicate that some marketing scholars are returning to this broad social viewpoint of the marketing process.

Microfilm \$3.90; Xerox \$13.20. 303 pages.



# AN APPRAISAL OF MARKET AREA COMPETITION UNDER THE ROBINSON-PATMAN ACT—1936-1957

(L. C. Card No. Mic 59-520)

George Edward Hartman, Ph.D.  
University of Illinois, 1958

This dissertation deals with the practicality of market area competition under the Robinson-Patman Act. Market area competition is defined as competitive pricing with geographic overtones. Moreover, market area competition has certain attributes. These attributes are: (1) full flexibility of sellers to respond to the quality, service, price and facilities extended by one another; (2) competitive rivalry within a specific geographical area; the extent of the area being determined by individual commodities or types of goods and competitive relationships existing between sellers; (3) varying competitive conditions in different geographic areas and during different time periods resulting in differential prices; and (4) the interchangeability or substitutability of goods -- that is, in the opinion of the buyer products of various producers can render equivalent product benefits.

The findings of this dissertation indicate that market area competition as defined above is very difficult to achieve legally under the Robinson-Patman Act, at least as it is currently being interpreted by the Federal Trade Commission.

In general, the Commission has considered price differentials almost *per se* violations of the price discrimination law. Also, the Commission has generally failed to recognize the importance of the spatial dimensions of markets. That is, the Commission has often construed the relevant geographical market for a commodity as the entire United States, rather than restricted geographical areas varying in degrees of competitiveness. Thus, any price differences between various geographical areas are, in the opinion of the Commission, discriminatory and legal only when based on cost savings. Under this approach the Commission has indicated that the primary force disturbing national price uniformity must be differences in cost of manufacture, sale, or delivery rather than the degree of competitiveness in individual markets. Still further, the Commission has interpreted injury to competition as meaning injury to competitors. Thus, the Commission has tenaciously held to the concept that general injury to competition can only occur through specific injury to individual competitors. Finally, the Commission has failed to recognize the possibility of heterogeneity between individual geographic markets. As a result of this attitude the use of differential pricing between individual markets has been effectively limited.

Perhaps the most significant conclusion of this dissertation was the ascertainment of the attitude of the courts toward market area competition. In general, the courts have led the Federal Trade Commission, although the Commission has often been reluctant, toward a more pragmatic reconciliation of the Robinson-Patman and Sherman Acts. Still further, the courts have been helpful in liberalizing the good faith defense doctrine, the definition of injury to competition, and the utilization of differential pricing. These are all manifestations of the primary attributes or elements of market area competition under the Robinson-Patman Act.

The Robinson-Patman Act is basically an anticompetitive law that was designed to protect the small independent

middlemen and consequently constitutes an exemption from the antitrust policy of hard or vigorous competition provided by the basic Sherman Act. The Robinson-Patman Act, in many instances, actually constrains the vigor of competitive rivalry. Thus, the use of practices which may be manifestations of hard competition, such as freight equalization, quantity discounts, and price cutting, are often precluded since they might cause injury to individual middlemen. The problem of reconciling the Robinson-Patman's goals of "soft" or "ethical" competition with the Sherman Act's concept of "hard" or vigorous competition is perhaps the major problem of antitrust regulation today.

In this dissertation a strategy of intermarket competition or "market mix" is developed. This strategy recognizes the heterogeneity of markets and makes full utilization of competitive pricing in varying geographical areas. It is in this strategy of intermarket competition that market area competition finds full expression as a competitive process. Microfilm \$4.35; Xerox \$14.60. 337 pages.

# AN AUDIT METHOD WITH AN APPLICATION TO MANAGEMENT PROGRAMS FOR DETERMINING DIFFERENCES OF OPINION WITHIN AND BETWEEN POLICY MAKERS, POLICY IMPLEMENTERS AND POLICY RECEIVERS

(L. C. Card No. Mic 59-217)

Michael Zev Massel, Ph.D.  
Northwestern University, 1958

Supervisor: H. Barrett Rogers

The purpose was to develop and test an audit method to assist in increasing the effectiveness of management development programs of individual firms. It was desired that the method should be rapid and economical in application. The audit would involve large proportions of a firm's management in shaping the plans for development, yet the procedure would be effective in large and small organizations.

Management development was defined as the process in which members of management, on an individual basis, are helped to improve their performance of current responsibilities and to prepare themselves for future assignments. The major burden for development is on the individual, but his superiors are responsible for providing an atmosphere conducive to his development.

Three basic requisites were postulated as essential to any management development program: 1. Policies must be established, or actively endorsed, by top management. 2. Policy and practice must coincide. 3. Individuals who are "being developed" must be aware of efforts in their behalf.

The reactions of members of management to items (selected statements or questions) relating to management development are to be recorded, summarized, analyzed and interpreted to determine the extent to which the three basic requisites have been satisfied. The members of top management indicate their opinions of what should be done regarding each item, while other members of management indicate their understandings of what is being done regarding the same items. Reactions are recorded arithmetically: -2 and -1 indicate choices against the items,



zero indicates a neutral reaction, while +1 and +2 indicate choices in favor of the items.

The audit was designed to direct attention to selected items and result eventually in: 1. Policy clarification. 2. Coincidence of policy and practice. 3. Improved communication between levels of management.

It was intended that the procedures could be self administered, with all steps of the audit and subsequent analysis being performed by company personnel.

The anticipated advantages of this audit method are:

1. Many people participate in the audit. 2. The involvement of many members in establishing future management development plans should insure representative reactions and induce increased cooperation with the plans. 3. The anonymous responses should result in frank and honest indications of opinions. 4. Different or unique goals can be established within the audit for each firm's own management development programs. 5. Analysis is simple and rapid, and results can be made available very soon after the last responding session.

A model audit was developed consisting of: 1. Questionnaires containing a list of 300 suggested items relating to management development. 2. A method of recording the reactions to the items for convenience in mechanical sorting and computing. 3. Methods of summarizing and interpreting the reactions. 4. A method of reporting the summaries of the reactions.

Two "follow-up" questionnaires were designed to confirm the accuracy of diagnosis and the practicality of the audit.

A field test was performed in The Pure Oil Company which investigated that company's administrative accounting trainee program. The stated purposes of the test were to obtain indications of: 1. Ease of developing an audit, tailored to individual needs of a specific company, from the items contained in the model audit questionnaires. 2. Facility with which an actual audit can be explained to management and trainees and with which responses can be obtained. 3. Facility with which responses can be summarized, analyzed and interpreted. 4. Time or costs involved for each step of the audit. 5. Meaningfulness of the analysis to the management of the company.

Ninety five items (questions) were adapted from the model audit for The Pure Oil Company test and responses were obtained from: the accounting management, the trainees' superiors, and the trainees. The responses to the "follow-up" questionnaires, and subsequent reactions from key members of management, indicated that the stated purposes of the field test successfully had been achieved.

The appendices include technical development of methods of interpretation, procedural instructions, the model questionnaires, and field test exhibits.

Microfilm \$5.55; Xerox \$19.40. 435 pages.

## ECONOMICS, HISTORY

### CANADIAN ECONOMIC THOUGHT, 1814-1914

(L. C. Card No. Mic 59-144)

Craufurd David Wycliffe Goodwin, Ph.D.  
Duke University, 1958

Supervisor: Joseph J. Spengler

This dissertation is an examination of Canadian economic thought from 1814 until 1914, a period in which the country developed from a number of isolated colonies into an autonomous nation within the British Commonwealth. The materials examined are mainly works of Canadian writers published as books, as pamphlets, in periodicals and in government publications.

Significant contributions to economic science were made by Robert Gourlay, by Edward Gibbon Wakefield, and by John Rae, all of whom wrote between 1815 and 1840 and on the theory of economic growth. Gourlay proposed a tax on the rent of land, calculated from the density of population, to force compact settlement and to raise funds for the construction of public works. Wakefield's suggestions were similar to those of Gourlay, but included restriction of the amount of land open to cultivation at any given time. Rae examined the nature of capital, and the determinants of saving and of invention.

Early discussions of banking and currency were dominated by merchants who patterned Canadian commercial banks after the first Bank of the United States. Critics voiced demands for extended banking facilities, for a government issue of paper currency and for safeguards in the bank charters. But the fundamental character of the banks did not change over the period. Because neither currency nor banking became important political issues bankers were not often required publicly to defend their positions.

Commercial policy was discussed as early as the eighteenth-century when arguments for tariff protection were put forward by farmers seeking an assured market for their products. Individuals who desired a diversified economy, together with many businessmen, proposed tariffs on manufactured goods. The writings of Friedrich List and Henry Carey were frequently cited as authority. In the eighteen-seventies protection was adopted as part of the "National Policy" of the Conservative Party. Arguments for free trade were presented by merchants and by financiers who hoped for the development of the St. Lawrence river as a trade route to the west, by individuals who supported the theories of the classical economists and by the Liberal Party. Free-traders made reference to such authorities as Smith, Ricardo and Mill; but as protection became increasingly popular criticism of basic protectionist principles became less frequent.

Economic science suffered from its association in the minds of many people with a policy of free trade. Before 1880 a few lectures were given on the subject and a very small number of articles was published in periodicals. But the subject was generally held in low repute. After the imposition of the "National Policy," however, problems of industrialization received attention in learned societies and from the government. In French Canada the characteristic emphasis on rural life and on classical education was gradually replaced by pleas for expansion of industry and commercial education. Economics did not become a



separate discipline in Canadian universities until these institutions had become relatively large and strong. A majority of the first academic economists received their training in Great Britain and brought to Canada the Scottish interest in practical economic problems, the Oxford tradition of economic history and to a lesser extent the theoretical economics of Cambridge. By 1914 the American influence had become pronounced through Canadians trained in graduate schools in the United States. The writings of the first academic economists reflected local conditions. Theoretical discussions were infrequent because of conflicts which would have arisen between laissez-faire conclusions and the governmental policy of granting tariff protection and subsidies to particular groups in the Canadian economy. The earliest writings were upon contemporary economic problems and upon economic history. With the exception of Gourlay, of Wakefield and of Rae, no Canadian writer made substantial contributions to economics before 1914. Microfilm \$5.20; Xerox \$18.40. 408 pages.

## ECONOMICS, THEORY

### LEVEL OF ASPIRATION AND CLASSICAL UTILITY ANALYSIS

(L. C. Card No. Mic 59-1296)

Owen Helwig Sauerlender, Ph.D.  
University of Minnesota, 1958

Classical economic theory is developed on the assumption that economic decisions are made on a rational basis. The criterion of rationality is that the decision maker has a well-defined system of preferences by which the outcomes of all decisions may be ordered, and, further, that

he will choose that alternative that will lead to his most desired outcome.

The classical models of the firm rest on the assumption that all information relevant to an economic decision is available to the firm without cost.

The maximizing postulates of classical economic theories have been challenged by the anti-marginalists, and, more recently, by Herbert A. Simon who has suggested that the economic organism may be more realistically described as acting so as to achieve some "level of aspiration" rather than the "maximum" in any given situation.

The object of this thesis is to show that the level of aspiration principle is not inconsistent with rational behavior in the sense defined above.

The arguments by which the objective of the study is achieved are based on extremely simplifying assumptions that make the model not necessarily representative of the real world. The level of aspiration decision rule that is developed rigorously for the very simple case is that the firm should continue its "search" for a more profitable investment opportunity than the best known to be available just so long as the expected "gross" gain from search is greater than the expected cost of further search.

It is also shown that where search is costless the firm, in general, will continue search until it has found all available information about all its investment opportunities and will thus be able to select the investment that will yield the maximum profit. It follows that the classical model is a special case, where the cost of search is zero, of the level of aspiration model.

Another conclusion of the analysis is that when businessmen's expectations are in general optimistic they will tend to invest more resources in search than will be the case when they are more pessimistic. This suggests that empirical evidence of the use by businessmen of a level of aspiration decision rule may be sought by analyzing the relationship between variations in their search (research) expenditures and variations in some index of their expectations with regard to business in general.

Microfilm \$2.00; Xerox \$3.00. 53 pages.

## EDUCATION

## EDUCATION, GENERAL

### RELATIONSHIPS BETWEEN CERTAIN CHARACTERISTICS OF STUDENTS AND GRADUATION OR NON-GRADUATION FROM GREENVILLE COLLEGE

(L. C. Card No. Mic 59-466)

Indimiun Daniel Baker, Ed.D.  
University of Illinois, 1958

During more than a quarter century a college degree has been the educational goal for a steadily increasing number of American youth. The number of college-age youth entering college has increased one percent per year for the last 20 years.

A great deal of research has been carried on for more

than 30 years for the purpose of identifying the characteristics of and the problems faced by the approximately 40 percent of those college enrollees who withdraw from college prior to the attainment of a degree. Certain limitations of and omissions from previous studies prevent the fullest utilization of this previous research in the development of programs designed to prevent this mortality and waste of human and material resources.

This study was designed to achieve three major purposes: To review the literature on dropouts for the purpose of developing a list of characteristics thought to be typical of those who drop out of college before graduation; on the basis of data concerning the characteristics thus identified, to compare graduates and dropouts who entered Greenville College as freshmen in the years 1945 to 1954 inclusive; and to examine seemingly reasonable



combination of those individual factors for the purpose of securing an improved basis for predicting proneness to dropping out of Greenville College.

The relationship between the criterion and each of the 37 individual characteristics selected for use in this study was examined by use of the Phi coefficient of correlation. The five percent level of significance was chosen because it seemed sufficiently rigorous and yet reasonable in facilitating further exploration.

A random sampling of the students who entered Greenville College as freshmen during the years 1945-54 inclusive, who either graduated or dropped out of college and who responded to the mailed questionnaire comprised the study population. A total of 198 graduates and 140 drop-outs was included.

Twenty-one of the 37 individual characteristics or indices showed a significant relationship to the criterion of graduation or non-graduation from college. These findings substantially agreed with the results of previous research.

The analysis of seemingly reasonable combinations of the individual factors which had shown a significant relationship to the criterion revealed a rather high multiple correlation coefficient when six or seven variables were included in the composite. No combination of two characteristics with the criterion increased the coefficient of correlation more than ten points. No combination of factors accounted for more than approximately one half of the variance between the two groups.

It would appear that further research needs to be made to determine that complex of forces operative on the Greenville College campus, whose resultant precipitates the decision to drop out of college. A theoretical construct should be formed in advance of gathering data so that the utmost usefulness of the data might be assured.

Microfilm \$2.00; Xerox \$6.60. 138 pages.

#### A COMPARATIVE STUDY OF MENTALLY GIFTED CHILDREN HETEROGENEOUSLY AND HOMOGENEOUSLY GROUPED

(Publication No. 22,982)

Mary Elizabeth Bell, Ed.D.  
Indiana University, 1957

Chairman: Ruth G. Strickland

#### THE PROBLEM

This investigation sought to discover the differences in specific growth areas between two groups of mentally gifted children: one group taught in a homogeneous classroom setting comprised solely of gifted children, the other group comprised of mentally gifted children selected from and taught in regular classroom settings composed of children of varying levels of intelligence.

The following specific areas of growth were considered:

- (1) certain basic personality traits of self-adjustment,
- (2) certain basic personality traits of social adjustment,
- (3) types and degrees of mental health liabilities, (4) types and degrees of mental health assets, (5) work-study skills, and (6) achievement in reading, vocabulary, arithmetic fundamentals, arithmetic problem solving, English and spelling.

#### METHODS AND PROCEDURES

The two groups, referred to as the homogeneous and heterogeneous groups, in this study were composed of 30 children each. All the subjects had recorded I.Q. measures of 125 or higher on the Stanford-Binet Individual Test of Intelligence. Each subject in the homogeneous group was matched with a subject from the heterogeneously grouped children on the basis of equivalent intelligence quotient. All children were in good health, at the fifth grade level, of approximately the same age, from comparable geographical locations, and had parental consent to participate.

The California Test of Personality, the Mental Health Analysis, the Iowa Every-Pupil Tests of Basic Skills, Work-Study Skills, and the Metropolitan Achievement Tests were given to both groups in the fall and again in the spring. The data thus obtained were then analyzed with regard to changes occurring in specific areas of growth, and comparisons were made between the two groups with regard to such changes.

#### MAJOR FINDINGS

The analysis of the data indicated the following conclusions:

1. With regard to personality traits of self-adjustment, no significant difference between the means of the homogeneous and heterogeneous groups occurred in any of the sub-scores on the first or second testing. However, the second testing showed a significant total raw score mean difference. Generally, it can be concluded that homogeneity had no real effect upon the personality traits of self-adjustment.
2. With regard to personality traits of social adjustment no significant difference between the means of the homogeneous and heterogeneous groups was found.
3. With regard to types and degrees of mental health liabilities no significant difference between the means of the homogeneous and heterogeneous groups was found.
4. With regard to types and degrees of mental health assets no significant difference between the means of the homogeneous and heterogeneous groups was found.
5. With regard to the work-study skills the total test achievement score for the second testing of the homogeneously grouped children exceeded significantly that of the heterogeneously grouped children, but limitations of this study tend to weaken the significance of this comparison.
6. With regard to achievement in reading, vocabulary, arithmetic fundamentals, arithmetic problem solving, English, and spelling a significant difference in total average grade equivalent for the second testing was found between the two groups. Discrepancies of correlation between I.Q.'s and achievement test results tend to weaken the statistical significance of these comparisons.

#### CONCLUSIONS

The results of this study indicate that some significance can be found in the differences between heterogeneously and homogeneously grouped children, but that this significance is not sufficiently strong to support the conclusion that homogeneity has a definite positive effect upon the mentally gifted child.

Microfilm \$3.05; Xerox \$10.40. 233 pages. Mic 58-5228



# AN ANALYSIS OF SELF-CONCEPTS OF PRESCHOOL CHILDREN

(L. C. Card No. Mic 59-363)

Alvia Lois Bozeman, Ph.D.  
The Ohio State University, 1958

The study was designed to examine and analyze the developing self-concepts of a group of preschool children. It sought answers to the following queries:

1. What self-concepts do a selected group of preschool children reveal?
2. How do age, previous group experiences, socio-economic status, and sex affect young children's developing concepts of self?
3. Is there a relationship between the educational level of the parents and the children's developing concepts of self?
4. Is there a relationship between parental attitudes toward child training techniques and children's expressions of self-concepts?
5. What techniques appear effective in helping children select and accept self-concepts involving co-operation, responsibility, considerateness, and respect for others?

Information obtained from such an investigation should (1) enhance awareness of the kinds of self-behaviors displayed by preschool children, (2) bring increased focus on the early childhood years as a time when possible lasting self-concepts are being formed, (3) contribute to the body of information designed to aid the school in more adequately counteracting possible undesirable influences or self-feelings evident in children's behaviors, and (4) aid in the recognition of potential areas of friction in developing self-concepts.

The basic instruments and techniques utilized were timed observations, interviews and a questionnaire, the Amen Anxiety Test, play with miniature toys, the Stogdill "Attitudes toward Parental Control of Children" and the Warner "Index of Status Characteristics"--rating scales.

Fifty-four children, ages three through five, were chosen from three school groups (a laboratory school, a co-operative school, and a child care center) in Columbus, Ohio, as subjects for the experiment. The subjects were selected on the basis of age, sex, and school adjustment rating.

The investigation utilized a dynamic interpretation of conceptual development and viewed self-concepts as tools that mirror the subjective uniqueness which gives to each personality a focus of consciousness and viewpoint from which to observe and operate. The following statements are the important conclusions of the study:

1. Self-concepts can be detected in preschool children through behavior and speech in group situations.
2. Behaviors indicative of initiative, autonomy, accomplishment, and trust were most often observed in the preschool children.
3. Evidences of the self-components of trust, autonomy and initiative decreased, while evidences of accomplishment increased as the child moved from the

three- to the five-year-old group. Three's were more aggressive, while five's were more anxious and tense.

4. Larger total self, inner tension and aggression scores were made by children in the middle socio-economic groups than by children in the lower socio-economic groups.
5. Girls revealed more autonomy, more inner tension, and less anxiety, and boys revealed more initiative, more aggression, and more anxiety in each age group.
6. When grouped by educational level of their parents, children (1) in the bachelor's group obtained the highest self-scores, (2) in the master's or above group obtained the lowest self and the highest tension scores, and (3) in the high school or less group obtained the highest aggression scores.
7. When classified according to parental attitudes toward control, children (1) in the neutral range revealed the least aggression and anxiety and the most symptoms of tension; (2) in the liberal range made the highest self-scores; and (3) in the conservative range revealed the fewest symptoms of tension and total self-scores and the most anxiety and aggression.
8. Increased knowledge about the frequently displayed behaviors associated with a sense of trust, autonomy, initiative, and accomplishment should enable teachers, at the early childhood level, to provide more carefully planned opportunities for the development of a basic sense of self-worth and value in young children.

Microfilm \$4.00; Xerox \$13.60. 311 pages.

# A COMPARATIVE STUDY OF THE WORD RECOGNITION ABILITIES OF GOOD AND POOR SPELLERS IN THE THIRD GRADE

(L. C. Card No. Mic 58-3519)

Naomi Caroline Chase, Ph.D.  
University of Minnesota, 1958

## Problem, Population, and Types of Measures Used

A contribution to the solution of one phase of the many-sided problem concerning the reasons why some children cannot spell, this study was conducted during the years 1956-1958 among the entire Grade Three population of the Roseville, Minnesota, public schools. Of the 474 children enrolled in the grade, 428 remained throughout the study to contribute scores on each of twenty word recognition measures of a diagnostic reading test; on a thirty-word dictation type spelling test; on a forty-word multiple-choice type spelling test; and on the Revised Stanford-Binet intelligence test.

## Groups and Statistical Treatment Involved

To select the good and poor spellers, and to obtain for these pupils their predicted spelling scores, regression



equations of spelling scores on intelligence quotients were used. The approximate twenty-five percent of the boys and of the girls who farthest exceeded expectation in dictation type and multiple-choice type spelling achievement became the individuals described as over-achievers. Similarly, the twenty-five percent who lagged farthest behind expectation became those described as under-achievers.

Considering boys and girls separately, the spelling over-achievers and under-achievers were compared in twenty word recognition abilities. In the comparisons between mean scores in word recognition measures where the variances were equal, the analysis of variance was used to test the significance of the differences. Where the variances were unequal and the distributions normal, the Behrens-Fisher test was used to determine significance of difference between the means. Where the distributions were definitely skewed, the Chi-Square test was used.

#### Findings Reported

The null hypothesis of no significant difference between the means of twenty word recognition measures of over-achievers and under-achievers in spelling was rejected for boys and girls for all twenty word recognition comparisons when dictation type spelling was used as the basis for grouping. Similar results were obtained for boys grouped on the basis of multiple-choice type spelling.

The girls in the category of multiple-choice type spelling presented the only significant deviations from a complete rejection of the eighty null hypotheses tested. For these girls, only fourteen of the twenty word recognition measures showed differences significant at the .01 level. Two were significant at the .01 to .05 level. The null hypotheses were accepted for initial errors, middle errors, ending errors, and letter sounds.

#### Conclusions Drawn

Within the limitations of the study, and completely applicable only to the population studied, the following conclusions were drawn:

1. Spelling over-achievers were significantly different from spelling under-achievers in a great majority of word recognition abilities measured.
2. Children in Grade Three, who efficiently used their capacities in learning to spell, applied many and varied word study techniques as they read.
3. With the exception of four word recognition abilities of girls grouped on the basis of multiple-choice type spelling, all over-achievers were superior in word recognition abilities to all under-achievers in both dictation and multiple-choice type spelling.

#### Implications Proposed

1. Young children learning to spell are more successful if, during their study, they are experiencing concurrent systematic study in word recognition skills in reading.
2. To insure efficient use of word recognition abilities possessed by children who are spelling over-achievers, the spelling program needs to employ broadly the use of word recognition techniques in all approaches to reading and to spelling, including the critical phase of children's proofreading their own writing.

3. The findings of the study support the generally accepted fact that the skills of spelling and reading are closely related during the early years in school, especially where the word-recognition phase of reading is concerned.

Microfilm \$3.20; Xerox \$11.00. 247 pages.

#### **THE MONTESSORI ELEMENTARY CURRICULUM CONTENT AND THE CORRESPONDING AMERICAN CURRICULUM CONTENT: A CROSS-CULTURAL STUDY**

(L. C. Card No. Mic 58-2808)

Joyce Costa-Minneci di Villareal, Ph.D.  
The American University, 1958

This study deals with the Montessori and the American curriculum content at the elementary level, analyzing the cross-cultural basis of the two in terms of modern art-science concepts. In the Montessori curriculum sense-education serves mainly for personality development. Sense-education functions within certain flexible limits of supervision. The American system of visual aids corresponds to Montessori sense-education. In each system there is the problem of discipline type or basis. These involve contrasting ideas deriving from the class value versus the democratic viewpoint. There is also conflicting appraisal of the effectiveness of spontaneous creative elementary design teaching. The problem is to resolve these conflicting viewpoints in terms of modern aesthetico-mathematical concepts.

Another aspect of the analysis is an inquiry as to possible fruitful extension of the curriculum programs to changing modern needs utilizing the rich resources of available art science scholarship.

The procedure was primarily an extensive analysis survey of the literature in the field of education, and in the fields of art-science technics bearing on practical elementary curriculum content, particularly on the points involving conflicting concepts. An extensive survey was also made of relevant material in contemporary science and the humanities that would supply a sound basis for extending an optimum functioning elementary curriculum content.

It appears that the analysis of the available art-science fields, as made, yields a broad basis for effective curriculum planning, appraisal, and fruitful extension.

It seems plausible to conclude that it is desirable to place greater emphasis on the teaching of mathematics through art form; that a preliminary three-year kindergarten period is desirable for initial schooling. It appears desirable that the art-science technics content might be profitably presented in closer relation to its historical and cultural setting.

Microfilm \$2.00; Xerox \$5.80. 119 pages.



# THE EFFECT OF TWO DIFFERENT WPM LISTENING RATES ON LEARNING AND RETENTION OF BLIND SCHOOL CHILDREN

(L. C. Card No. Mic 59-504)

Mitat Ahmet Enç, Ph.D.  
University of Illinois, 1958

The problem of this investigation was to study the learning and retention effects of listening to relatively long narrative type material at two different wpm rates on blind school children. The purpose was to determine whether learning efficiency would be enhanced through faster word per minute rates than the usual rate of the average talking book used by blind people.

Twenty-one blind subjects from the Illinois Braille and Sight Saving School for the Blind at Jacksonville, Illinois were selected. Subjects ranged in IQ from 89 to 144 and were in seventh through 10th grades. The main group was divided into three subgroups--seven subjects in each--equated in mean IQ 113, 114.4 and 110 respectively. The groups were randomly designated as Experimental Group I, Experimental Group II, and Control Group.

The analysis of the data involved the use of Lindquist's Type I mixed design, his treatment x level design, and the sign test.

For 10 of a series of 12 consecutive days the two Experimental Groups listened to 10 stories recorded on tapes and taken from SRA Better Reading Books Series, Book 2. The series was tape recorded once at approximately 172 wpm, commonly used with talking books. They were then taped at an average of 37 wpm faster. Following the listening period, subjects answered 20 multiple choice questions. Twenty-four hours later the test was repeated. They then listened to another story and took the test. The Control Group took the 10 tests without listening to the stories. Also, the two Experimental Groups expressed their opinions about (a) the content of the stories, and (b) the two speeds used. Responses were recorded by braille writers and slates.

## Results

The major results of this study may be summarized as follows:

1. As a check on the familiarity of the materials, the Control Group who did not listen to the stories obtained significantly fewer correct answers than did the two Experimental Groups who heard the stories.
2. The efficiency of faster wpm rate for immediate learning per unit of listening time was indicated by the following: (a) using the F test there was a significant difference in favor of the fast wpm rate for the second set of five stories, but the significance did not reach the five per cent level on the first set of five stories (although the difference was in the right direction), and (b) on the sign test the significance for the whole series exceeded the .02 per cent level.
3. Retention after 24 hours, as measured by a repetition of the test on the two Experimental Groups, showed the following results; (a) using the F test, there was a significant difference in favor of the fast wpm rate for the second set of five stories, but the significance for the first set of five stories did not reach the five per cent level (although the difference was in the right direction), and

(b) on the sign test the significance for the whole series exceeded the .02 level.

4. Tests on the opinions of the subjects concerning the story contents did not show any significant relationship between liking and disliking the story on the two wpm rates.

5. Subjects generally liked both wpm rates, but preferred the slow rate as satisfactory more often than the fast rate. The sign test showed a statistically significant difference on this factor.

Educational implications and further research problems were also discussed.

Microfilm \$2.00; Xerox \$4.60. 89 pages.

# AN EXPERIMENTAL STUDY OF THREE DIFFERENT PATTERNS OF STUDENT PARTICIPATION IN A GENERAL-EDUCATION SCIENCE COURSE FOR COLLEGE FRESHMEN

(L. C. Card No. Mic 58-1178)

Benjamin Edward Hatcher, Ed.D.  
Wayne State University, 1957

## Purpose and Problem

The purpose of this study was to investigate the relationship between (a) degree of student participation in planning and evaluating the work done in a given course and (b) level of achievement in knowledge of subject matter in the course. The specific problem was to determine to what extent, if any, do scores on objective tests differ among three groups of students whose classroom experiences have been sharply different with respect to amount and type of student participation in planning and directing their own work in a general education science course.

## Plan of the Study

The general plan of the study included (1) the development of three different patterns of instruction--one representing a high degree of student participation (individual-consultation), another representing a moderate degree of student participation (group-discussion), and the third representing relatively little student participation (class-recitation), (2) the selection of three groups of beginning freshmen, each to be taught by one of the three methods for a school year, (3) the selection and construction of tests to be used as measures of achievement, (4) the development of appropriate statistical procedure for evaluating obtained differences among the three groups of students in their achievement on the tests.

## Procedure

The study was conducted at Alabama State College during the school year 1954-55. In September 1954, the three experimental groups were selected from among the groups registered in the general-education science courses for freshmen. Performance on the Iowa Reading Test was the primary basis for initial selection of the groups. Comparability of the three groups was further established by additional data obtained from other tests.

The author of this report was assigned to teach all three experimental sections for the full academic year. A conscious attempt was made by the instructor to manifest equal interest and enthusiasm for each of the three



methods used. The same course materials were available to all.

Test designed to measure subject-matter mastery by recognition and recall were selected or constructed and administered at designated intervals. Some of these tests were administered twice, others were administered only at the end of the course. Test data were analyzed to determine the statistical significance of differences among the three groups with respect to achievement.

#### Summary of Findings and Conclusions

The three methods were found to produce approximately equal results in:

1. developing a knowledge and understanding of course content over the period of the entire course,
2. developing a knowledge and understanding of course content as background information for advanced study in related fields,
3. developing ability to understand and interpret scientific information written in popular periodicals,
4. developing ability to apply the scientific approach in judging statements commonly accepted as facts.

Although the experimental group employing maximum student participation made slightly higher scores than the other two groups on most of the tests, these differences in most instances did not even approach statistical significance. Microfilm \$3.40; Xerox \$11.60. 264 pages.

#### A REPORT OF AN OREGON SCHOOL CAMP WITH PROGRAM EMPHASIS UPON OUTDOOR SCIENCE EXPERIENCES

(L. C. Card No. Mic 59-830)

E. Irene Hollenbeck, Ed.D.  
University of Colorado, 1958

Supervisor: Associate Professor Harold M. Anderson

The purpose of the study were: (1) to ascertain the amount and kinds of outdoor science experiences now provided for the children of Oregon by schools and other agencies, and (2) to investigate the feasibility and value of presenting outdoor science experiences at a school camp.

Data for the first part of the study were obtained from questionnaires completed by 601 seniors in twenty-four of the 224 public secondary schools in Oregon. The high schools were selected by techniques which provided a stratified random sample. The findings of the survey were compared with those of a similar survey made of 495 college freshmen two years earlier.

Since these findings supported the writer's initial belief that the children of Oregon had little opportunity to participate in outdoor science experiences plans were made for the organization and administration of a pilot science school camp. With Southern Oregon College and the Medford Public Schools as co-sponsors, the camp was held during the last week of April, 1957, at a site leased from an established church camp. Twenty-two fifth and sixth grade children were taken on morning and afternoon field trips

by resource people expert in the areas of conservation, geology, ornithology, forestry, and aquatic biology.

An analysis of the effectiveness of this type of learning experience was made by a study of (1) the precamp and postcamp sociometric tests, interest inventories, and artistic representations, (2) opinion questionnaires to parents and participants, and (3) interviews with the classroom teacher, resource people, and administrators.

An insight into the feasibility in terms of costs and administrative problems was made from an analysis of the records kept by the camp director, and the reactions of the parents, administrators, and resource persons involved.

From the findings obtained the following conclusions were drawn:

1. Too few children in Oregon have had an opportunity to participate in outdoor science experiences.

2. Too little use has been made of skilled resource personnel as leaders of outdoor science experiences.

3. The school camp was worthwhile because the children showed evidence of growth in an appreciation of the interrelationships of living things and of the beauties of nature, developed knowledges and skills related to outdoor science and outdoor living, exhibited desirable attitudes toward work and conservation practices, found areas in which their individual abilities could be recognized, and acquired new science interests.

4. The school camp was of value to the teacher in helping him identify new areas in which specific children could succeed and in which certain individuals needed help in meeting the problems of living.

5. School camping was feasible in southern Oregon because it was possible to lease a campsite from an organization which maintained an established summer camp, the cost was nominal, and resource personnel were willing to assist. School districts located near colleges having teacher education programs should experience little difficulty in securing counselors. Only further experimentation with pilot school camps can determine the extent to which it is feasible in other regions of Oregon.

Results of the investigation prompted the writer to recommend (1) that directors of camps and teachers of science be encouraged to increase their use of outdoor laboratories and skilled resource personnel, (2) that more communities experiment with presenting outdoor science at school camps or find a way to establish and maintain an outdoor science laboratory, (3) that instrument be developed which will aid in the appraisal of the educational outcomes of school camping, and (4) that college courses for camp counselors include a unit on nature or outdoor science.

A report of the science camp experience in the form of a 16 mm colored motion picture was made available through Southern Oregon College for use in the development of other outdoor education projects.

Microfilm \$3.10; Xerox \$10.60. 239 pages.



**RADHAKRISHNAN'S WORLD AND EDUCATION:  
AN ANALYTIC INTERPRETATION OF THE ROLE  
OF EDUCATION IN THE WORLD-PHILOSOPHY  
OF SARVEPALLI RADHAKRISHNAN**

(L. C. Card No. Mic 59-869)

Roscoe Sydney Lowry, Ed.D.  
University of Southern California, 1958

Chairman: Professor Brackenbury

The purpose of this study was to present an analytical interpretation of the role of education in the world-philosophy of Sir Sarvepalli Radhakrishnan. The problem involved a consideration of the relationship of the role of education to the metaphysical presuppositions of Radhakrishnan's world-concern, as well as to the objective which his "way of life" presents. The procedure of study was that common to philosophical and documentary research. Source material consisted chiefly of the works of Radhakrishnan and his critics.

**Findings.** Following ontological reasoning, Radhakrishnan postulates an ultimate reality (Brahman) as the logical prius to existence. Of the nature of reality, he concludes that the Absolute is spirit (Atman) with primary characteristics of blissful freedom (ananda) and creative expression (lila). Central to his monistic position is an organic view in which variations of existence are interacting parts of the Real, the greater whole. The human self is an experience in the progression of parts toward the ideal of the unity of all in the completeness of the universal Self, Brahman. The goal of man is thus one of harmony, unity and oneness, but also happiness inherent to free expression of one's self. As an agent of liberty, education facilitates the realization of "freedom" (moksa) through the harmony which exists with one's self and with others as there is voluntary subjection to the good of the whole in consequence of "self-realization" through Brahmanubhava (insight to reality).

**Conclusions.** The role of education is integral to the philosophy of Radhakrishnan. It has its roots deep in the Hindu metaphysical heritage. Having no goal of its own, but only instrumental value, the relation of the role of education to the way of life presented is that of agent and chief means in bringing life's objectives to fruition. Its concern, therefore, is with optimum realization of individual freedom through increased spirituality and the development of the "socialized" outlook which accepts the ideal state as one in which there is a genuine world-community based on the reality of human brotherhood.

**Recommendations.** Among the recommendations presented for education were the following: (1) Education should serve to meet the practical and total demands of the experiences of life, not excluding the spiritual. (2) Since spiritual (social) growth is the chief concern in life, the curriculum should facilitate "integrated living" through activities designed to exercise the spiritual (human) virtues. (3) Education should concern itself with social reconstruction only in so far as this may be accomplished through character transformation. (4) The concern should not be so much to indoctrinate "right" ideals as to condition the pupil in a passion for the free pursuit of Truth. (5) Education should bear the responsibility of transmitting the human heritage of values, but only after these have been creatively transformed into currently effectual

principles. (6) It should provide a sense of conviction, but only such as does not, however, foreclose on the disposition for research. (7) Education should exert a unifying influence and counteract extreme nationalism and other divisive forces at variance with the ideal of unity and the natural tendency to fellowship.

Microfilm \$8.30; Xerox \$28.20. 655 pages.

**TEACHER LOAD IN CALIFORNIA  
PUBLIC JUNIOR COLLEGES**

(L. C. Card No. Mic 59-244)

Austin John Mattila, Ed.D.  
Stanford University, 1958

Purpose and Procedure of the Study

The purpose of this study was to obtain information that would aid in the assignment of teacher load to public junior college instructors. To fulfill its purpose, the study surveyed the practices followed by thirty-nine California public junior colleges in assigning teacher load. It examined the instructional assignments of 1686 instructors teaching in seventeen different subject fields in forty-five California public junior colleges. Still further, it elicited the attitudes of 888 instructors who taught in thirty-eight California junior colleges toward their teacher load. Lastly, it brought together the recommendations regarding teacher load of junior college professional organizations, faculties, specialists, and 888 instructors who participated in the study.

Findings and Recommendations for Junior  
College Instructional Assignments

A major guideline for assigning lecture-hours is that the base should be fifteen lecture-hours per week. The findings which support this recommendation are, first, that a majority of twenty-three of the thirty-nine junior colleges surveyed used this base. Secondly, the instructors who had been assigned fifteen lecture-hours were, in the main, satisfied with this number of classroom hours. Lastly, the majority of instructors and groups queried by this study recommended fifteen lecture-hours as the base for assigning classroom hours.

There was general agreement in practice and in the recommendations for junior college instructional assignments that instructors teaching laboratory sections could be assigned more classroom hours than instructors teaching only lecture sections. The evidence shown by the hourly work weeks of instructors supports this distinction--instructors teaching laboratory hours, on the average, spent less time in out-of-class instructional activities than did instructors who taught solely lecture sections. However, the data regarding the weight which the laboratory-hour should bear to the lecture-hour was not clearcut. Of the twenty-six junior colleges which used a ratio of laboratory hours to lecture-hours, fourteen used a 2 to 1 ratio, and twelve colleges used a 1-1/2 to 1 ratio. This study favors the 1-1/2 to 1 ratio due to its finding that the largest percentage of instructors who expressed dissatisfaction with number of classroom hours were those who taught



laboratory hours--40 per cent of the science instructors felt that they taught too many classroom hours.

In accordance with the findings pertinent to present practices as well as recommendations of groups and individuals polled by this study, the recommended maximum number of course preparations for junior college instructors is three.

The findings of this study pointed to no specific figure which could be used as a standard for sectioning lecture classes. However, this study focuses upon the range 30-35 students which takes in the most common practice of class sectioning as well as the recommendations of instructors regarding the size of lecture classes.

The recommended range for laboratory sections is 20-25 students. This range conforms with present policies as well as the recommendations of instructors for class size for laboratory sections.

#### Recommendations for Further Research

Because instructors in the smaller junior colleges carried the heaviest instructional assignments and expressed the greatest degree of dissatisfaction with their assignments, this study recommends further research to learn the effect of heavy instructional loads upon the efficiency of instruction in the small junior college.

#### Future Studies of Teacher Load

Current experimentation regarding better use of teacher time by having assistants perform routine clerical tasks, use of varying class sizes, and differing numbers of class meetings per week forecasts new concepts of teacher load which suggest the need for further studies of teacher load.

Microfilm \$4.70; Xerox \$15.80. 368 pages.

### **A COMPARATIVE STUDY OF THE WORD RECOGNITION ABILITIES OF GOOD AND POOR READERS IN THE THIRD GRADE**

(L. C. Card No. Mic 58-3552)

Ruby Norine Odland, Ph.D.  
University of Minnesota, 1958

#### **PURPOSE AND PLAN OF THE STUDY**

The purpose of this study was to investigate the relation of word recognition abilities of children to success in reading comprehension and speed of reading. Reading achievement tests and diagnostic reading tests were administered to all of the 474 third grade pupils enrolled in the Roseville, Minnesota, Public Schools in May, 1956. Individual intelligence tests were administered during the following school year.

Regression equations, based on intelligence quotients, were set up for the purpose of predicting reading achievement. For purposes of the regression equations, the boys and girls were combined since no statistical difference was observed between these groups so far as intelligence was concerned. The boys and girls were statistically different in the reading achievement measures so the 226 boys were studied separately from the 202 girls. For each sex and for each type of reading, the twenty-five

percent of the individuals whose reading scores exceeded their predicted scores to the greatest extent were classified as most successful. Similarly, the twenty-five percent of the individuals whose reading scores fell farthest below their predicted scores were classified as least successful. With these groups, comparisons were made of mean scores on each of the twenty word recognition measures.

F tests were used to test homogeneity of variance in each of the twenty word recognition measures. When no significant differences in variability of the groups were found, analysis of variance was used to test the significance of the difference between the mean scores of the most successful compared with the least successful. The Behrens-Fisher test was used for those measures on which the variances were significantly different and the Chi-Square test was used when the distributions were definitely not normal.

#### FINDINGS

The hypothesis of no difference between the means was rejected for both the boys and the girls in all twenty word recognition measures when the basis for grouping was level of comprehension. The .01 level of confidence was the point arbitrarily set for considering the differences significant.

The null hypotheses for boys grouped according to speed of reading were rejected in seventeen of twenty measures. The three tests of word recognition in which there was no significant difference between the most rapid boys and the least rapid boys were initial errors, beginning sounds, and letter sounds.

The hypothesis of no difference between the means for girls grouped on the basis of speed of reading was rejected in each of the twenty word recognition measures.

#### CONCLUSIONS

1. Most successful readers were different from least successful readers in the majority of word recognition measures.

2. In the most successful and the least successful groups of boys formed on the basis of speed of reading, the differences which were not significant were in measures of initial errors, beginning sounds, and letter sounds. This could be interpreted to be a grouping of the abilities involving some of the most detailed break-downs of words.

3. For groups based on level of comprehension, no one group of recognition abilities was unique in characterizing the most successful readers, but rather in all types of word recognition abilities the most successful groups were shown to be significantly different from the least successful achievers. It appears that broad word study techniques characterize the superior achiever in level of comprehension.

From the findings it can most certainly be concluded that, for this particular population, the most successful readers are different from the least successful readers in word recognition abilities and that their superiority is not limited to any one area of word recognition.

Microfilm \$3.40; Xerox \$11.60. 262 pages.



# AN EXPERIMENTAL STUDY OF THE PROBLEMS AND ATTITUDES OF HIGH SCHOOL ATHLETES

(L. C. Card No. Mic 59-840)

Edward James Smith, Ed.D.  
University of Colorado, 1958

Supervisor: Professor David C. Bartelma

The purpose of this study was threefold: first, to determine if high school athletes showed improvement in their attitudes as the result of a self-adjustive coach-athlete conference approach to counseling; secondly, to determine if individuals who had been successfully counseled differed from those unsuccessfully counseled in the amount of attitude improvement shown; and thirdly, to investigate the problems and needs of high school athletes.

The population studied was composed of approximately one hundred athletes attending Arroyo High School in San Lorenzo, California. The IAO Rating Scale was administered in order to measure student attitudes in this study, and the Mooney Problem Check List was administered in order to survey student problems. The experimental variable used in the experiment was a series of self-adjustive coach-athlete conferences. This counseling process aimed toward the goal of self-direction and self-realization on the part of the athlete. Basic hypotheses and working principles were formulated in order to standardize the counseling approach for coaches. In an attempt to validate the counseling approach for use by coaches in general, two coaches qualifying as untrained counselors were enlisted as co-workers in executing the experimental variable. When a case was closed the typed recording was analyzed by the investigator and another qualified counselor on the basis of certain internal criteria and labeled successful or unsuccessful. In addition to presenting the statistical results of the experiment, the group findings resulting from the problem check lists and the principal findings resulting from the conferences were also presented and analyzed.

Students were expressive in using the problem check list, underlining an average of twenty-nine problems in the study. Although the athletes marked the greatest number of problems in the area of their adjustment to school, they indicated that the future with its educational and vocational problems comprised the area of most concern to them. Athletes apparently welcomed the opportunity to talk to the coach about some of their problems.

The statistical analysis indicated that the attitudes of the experimental group did not differ significantly from those of the control group after the experiment. Although the successful cases showed more improvement in attitude than the unsuccessful cases, the improvement was not statistically significant. The statistical decision arrived at in both cases was that the null hypothesis could not be rejected.

More than half of the counseling cases were rated as successful on the basis of the internal criteria. The two coaches untrained in the area of counseling and guidance enjoyed as high a ratio of success as did the formally trained counselor.

The following factors contributed most heavily toward the success of conferences:

1. Previous rapport.
2. An anxiety-producing problem disturbing the athlete.

3. Coach remaining objective, uninvolved, and quiet.
4. Coach having reviewed problem check list prior to conference.
5. Scheduling conferences during the students' class time.

Athletes oftentimes voluntarily discussed problems which were directly related to athletic achievement. Also the approach was useful to the coach in "selling" athletes on cooperating with some phase of the athletic program. The excellent turn-out of athletes requesting conferences following the experiment suggested that the experimental variable was successful and had been publicized as such by the experimental group.

It was the conclusion of the writer that attitudes or feelings toward basic concepts do not generally change as the result of an experience of this nature. Nevertheless, athletes and coaches derive numerous benefits from such a relationship.

Microfilm \$3.00; Xerox \$10.40. 232 pages.

# A STUDY OF THE EFFECTIVENESS OF VISUAL AIDS IN FARM MANAGEMENT INSTRUCTION AMONG STUDENTS OF SENIOR HIGH SCHOOL GRADES

(L. C. Card No. Mic 58-7025)

Deane A. Turner, Ph.D.  
University of Minnesota, 1958

Adviser: Milo J. Peterson

**Purpose.** The purpose of the study was to determine the effectiveness of visual aids in teaching Farm Management with farm accounts as a basis for the instruction and to determine through this instruction, the achievements of sophomore high school students as compared to those of junior and senior grades.

**Method.** The data were collected from a sample of 60 students in attendance at the Southern School of Agriculture during 1957-1958. Raw scores from a pre-test, a post-test and those from a standardized test on verbal reasoning were given statistical treatment.

Four groups of fifteen students each were involved in the experiment. Two of the groups consisted of sophomore students - one was identified as the control where customary instruction was employed; the other which involved the same content of instruction was supplemented with special visual aids. Junior and senior students made up corresponding control and experimental groups.

The 60 students were given 12 weeks of instruction. A staff member of the school taught all four groups. Classroom materials prepared in advance of instruction included farm account books for all students complete with entries and totals and copies of annual summaries of a farm management association. A reference textbook on the subject of farm accounting and farm management co-authored by the writer of the study was made available to all students.

The 100 item pre-test was given to all students prior to any instruction and, at the end of the twelve weeks, the same test was administered as a post-test. Three unit tests were constructed and administered to all students



at appropriate intervals during the instructional period primarily to motivate learning and evaluate the progress of teaching. The visual aids used to supplement the teaching of the two experimental groups involved the use of  $3\frac{1}{4}$ " x 4" standard slides and the overhead projector.

**Findings.** The initial treatment of data involved a test of variances among post-test scores of the four instructional groups. The  $L_1$ -test was applied as the test of significance. The variances were found to be homogeneous. This was followed by a test to determine the homogeneity of means of the post-test scores of the groups. The F-test was applied as the test of significance at the 5% level and the means were found to be homogeneous.

The variance and covariance technique was then applied to determine the effects on the means of post-test scores with the independent variables, verbal reasoning and pre-test, partialled out. The F-test was used to test significance. Results indicated that when the verbal reasoning variable alone was partialled out, the means of post-test scores were homogenous; however, with partialing out of both verbal reasoning and pre-test, significant differences were found among the means of post-test scores of groups.

A two-way analysis of variance was then applied, with the F-test as the test of significance, to determine homogeneity of means of post-test scores corrected for verbal reasoning ability and pre-test achievement of students. To accomplish this, three hypotheses were drawn from the mathematical model of the study to which the F-test was applied in each case. The testing of these hypotheses indicated that there were no significant differences in means of post-test scores between grades, between treatments and that no significant differences resulted from the combined effects of grades and treatments of the four groups.

**General Conclusions.** It was concluded that (1) visual aids were not effective as a supplement to the teaching of farm management with farm accounts as a basis for the instruction and (2) that in farm management instruction, sophomore high school students achieved comparably to students of the junior and senior grades.

Microfilm \$2.00; Xerox \$6.80. 144 pages.

## EDUCATION, ADMINISTRATION

### BASES FOR ESTABLISHING JUNIOR COLLEGES IN COLORADO

(L. C. Card No. Mic 59-820)

Dwight Calvin Baird, Ed.D.  
University of Colorado, 1958

Supervisor: Professor Calvin Grieder

The purpose of this study is to set up criteria which may be used as dependable guides in determining the feasibility of establishing a public junior college in any section of Colorado.

A survey of the history, philosophy, status, trends, and functions of junior colleges was made by reviewing the

literature of the junior college movement in the United States, and through an examination of the laws governing the establishment of junior colleges in the various states. The growth of the junior college movement from eight colleges in 1900 to 645 institutions in 1957 indicates an increasing need for and prospects of continued growth and development of the junior college.

Bases suggested by twenty-three writers in the field of junior college education and laws governing the establishment of junior colleges in twenty-six states were analyzed and evaluated. Eight bases or criteria to govern the establishment of public junior colleges in Colorado were formulated. These criteria were applied to all sections of the state, and a total of twenty-two junior college districts which meet the minimum standards established in the criteria were identified.

The eight bases proposed in the study for the establishment of junior colleges in Colorado are:

1. An anticipated minimum enrollment of 200 students.
2. An average of 200 high school graduates annually in the district.
3. An average of 1,000 students enrolled annually in the four-year high schools of the district.
4. A minimum population of 20,000 people in the district.
5. An assessed valuation of not less than \$20,000,000.
6. The junior college district shall consist of one or more contiguous counties; and the college or colleges operated by the district shall be located within forty miles of as many of the people of the district as conditions will permit.
7. Approval of the plans for the establishment of a public junior college district by a majority of the school electors of the proposed district.
8. A public junior college shall be established only after a survey by the State Department of Education, and a favorable report of the proposal by the Department.

The twenty-two junior colleges suggested in the study are located as follows:

1. Adams City, the district to consist of Adams County.
2. Englewood, the district to consist of Arapahoe and Douglas Counties.
3. Longmont, the district to consist of Boulder County.
4. Denver, the district to consist of Denver County.
5. Colorado Springs, the district to consist of El Paso, Park, and Teller Counties.
6. Canon City, the district to consist of Fremont, Chaffee, and Custer Counties.
7. Glenwood Springs, the district to consist of Garfield, Eagle, Lake, Pitkin, and Summit Counties.
8. Lakewood, the district to consist of Jefferson, Clear Creek, Gilpin, and Grand Counties.
9. Durango, the district to consist of La Plata, Archuleta, Dolores, Hinsdale, Montezuma, and San Juan Counties.
10. Fort Collins, the district to consist of Larimer and Jackson Counties.



11. Trinidad, the district to consist of Las Animas and Huerfano Counties.
12. Limon, the district to consist of Lincoln, Cheyenne, Elbert, and Kit Carson Counties.
13. Sterling, the district to consist of Logan, Phillips, and Sedgwick Counties.
14. Grand Junction, the district to consist of Mesa County.
15. Craig, the district to consist of Moffat, Rio Blanco, and Routt Counties.
16. Montrose, the district to consist of Montrose, Delta, Gunnison, Ouray, and San Miguel Counties.
17. Fort Morgan, the district to consist of Morgan, Washington, and Yuma Counties.
18. La Junta, the district to consist of Otero, Bent, and Crowley Counties.
19. Lamar, the district to consist of Prowers, Baca, and Kiowa Counties.
20. Pueblo, the district to consist of Pueblo County.
21. Monte Vista, the district to consist of Alamosa, Conejos, Costilla, Mineral, and Saguache Counties.
22. Greeley, the district to consist of Weld County.

The seven public junior colleges now located at Durango, Grand Junction, La Junta, Lamar, Pueblo, Sterling, and Trinidad are included in the twenty-two junior college districts in the proposed state-wide plan.

Microfilm \$3.80; Xerox \$12.80. 294 pages.

#### A QUANTITATIVE-QUALITATIVE ANALYSIS OF SELECTED SOCIAL SCIENCE GENERALIZATIONS IN SOCIAL STUDIES TEXTBOOKS IN THE INTERMEDIATE GRADES

(L. C. Card No. Mic 58-5748)

Lillian M. Dimitroff, Ph.D.  
Northwestern University, 1958

Adviser: E. T. McSwain

#### PROBLEM

The object of this study was to evaluate quantitatively and qualitatively the ten social studies textbooks most widely used in each of the intermediate grades in ten selected large city school systems. This appraisal of textbooks was made in terms of 15 selected social science generalizations, judged significant, by a jury of scholars, for a democratic social system.

#### PROCEDURE

The procedures followed were: (1) selecting, developing, improving, and establishing 15 generalizations with the assistance of an interdisciplinary jury of scholars, (2) selection of social studies textbooks used in the intermediate grades in selected school systems, (3) quantitative-qualitative analysis of the textbooks by means of a

word count, (4) interpretative evaluation of data from which were derived specific findings and recommendations.

The generalizations used in this study are illustrated by these two samples:

11. Science and technology have distinctly modified man's efficiency to utilize the resources of the earth and the significance of climate.
13. Physical and cultural diversities have, in part, occasioned great economic, political, and social issues of modern times.

The remaining thirteen generalizations were set forth in the dissertation.

The procedures used by the analyst in determining quantity and quality follow. The individual word was used as the unit of appraisal except for proper names which were tallied as one word. Words were considered textual matter, whereas all other categories of textbook content were classified as non-textual data. Pictures, graphs, etc., were first converted to square inches and then into equivalent word-displacement space. Textual data were recorded on one work sheet and non-textual data on another. The following ratings of quality were used: "excellent," "good," "fair," "poor," and "negative."

The data derived from analyzing the 30 textbooks were evaluated both quantitatively and qualitatively. An appraisal was made of the substance of the 15 generalizations with respect to: (1) summarization of the total wordage of the substance of the 15 generalizations combined, (2) the wordage of each separate generalization, (3) the wordage of textual and non-textual matter for each of the 15 generalizations, (4) the wordage of the 15 generalizations in textbooks of the fourth, fifth, and sixth grades, (5) the wordage of the generalizations in geography, history, and fused textbooks, (6) the percentage of the total space occupied by the substance of the generalizations as well as their quality in all of the aforementioned categories, and (7) the number of books which treated each of the 15 generalizations.

#### FINDINGS AND CONCLUSIONS

1. The quantity and quality of attention to 15 generalizations was very uneven in the 30 textbooks.
2. There was more non-textual than textual wordage.
3. The quality of wordage inclined more toward "excellent" and "good" than toward "negative" and "poor."
4. The four generalizations (Nos. 5, 7, 10, and 13) to which the least wordage was devoted were, in three cases (Nos. 5, 7, and 10) out of four, present in the sixth-grade textbooks.
5. The five generalizations (Nos. 1, 2, 9, 11, and 12) treated in the largest word space (in proportion to the total number of words in textbooks) were on the fourth-grade level.
6. No qualitative trend was established with respect to the three grade levels.
7. No pronounced quantitative and qualitative trends appeared respective to fused, geography, and history textbooks.
8. The generalization which received the most wordage was No. 11, and the generalization whose substance was stated in the fewest words was No. 13, both cited above.

Microfilm \$7.55; Xerox \$26.20. 593 pages.



# THE OREGON SECONDARY-SCHOOL PRINCIPAL AND HIS JOB

(Publication No. 20,200)

Harold Vanderver McAbee, Ed.D.  
University of Oregon, 1957

Adviser: Arthur C. Hearn

## Purpose of the Study

It was the purpose of this study to (1) investigate the various aspects of the status of Oregon public secondary-school principals; (2) determine their formal training and certification status; (3) determine their professional experience; (4) ascertain the relative amounts of time spent in each of thirteen categories of duties performed by the principals; (5) determine a criterion for the expenditure of time on the job; (6) briefly compare the status of Oregon principals with those from other states and with Oregon principals of 1940-41; and (7) make recommendations concerning the pre-service and experience training as preparation for the principalship.

## Procedures

Data for Oregon principals were gathered through a diary study and use of three different questionnaires. Authorities in the field supplied data for the criterion for the expenditure of the principal's time through the medium of a questionnaire. Data were derived from similar studies for principals in other states and Oregon principals of 1940-41. The literature in the field of secondary-school administration was consulted in reference to establishing a concept of the secondary principal's job.

Two hundred forty-one public secondary junior and senior high school principals were included in the study.

The study originated in the Executive Committee of the Oregon Association of Secondary-School Principals, and was cooperatively sponsored by that Association, the State Department of Education, the Northwest Cooperative Project in Educational Administration, and the School of Education, University of Oregon.

## Summary and Conclusions

The median secondary principal held a one-year contract which stipulated that he work 10.3 months for \$6,006. Principals in larger schools enjoyed contractual advantages in several respects over principals in smaller schools. Fifty-three per cent of the principals administered four-year high schools. Fifty-five per cent of the principals served in a dual capacity as superintendent-principal. Principals averaged teaching one class per day.

The principals averaged 42 years of age, was married, and the father of two children. Principals in smaller schools were younger and had entered the principalship at an earlier age than principals in larger schools.

Only about 1 in 8 of the principals had published an article in a professional journal. The median principal read 4 professional periodicals monthly and belonged to 4 professional organizations. He rated the value of the membership in these organizations midway between fair and good.

Only 20.2 per cent of the principals indicated that the secondary principalship was their professional goal. Over twice that proportion desired to be superintendents.

## Training Certification.

Oregon principals in 1954-55 had received formal training from at least 3 different institutions of higher learning. Most of the principals were educated and served in their home state. Seventy-two per cent of the principals majored in School Administration and Supervision at the graduate level. Only 10 per cent were majors in Secondary Education. The principals reported a mean of 81.6 quarter-hours credit earned in professional education courses. They had earned credit within five years preceding the study. Eighty per cent of the principals held the master's degree. The principals rated the value of their formal training at 2. (adequate) as preparation for the duties which they perform.

All but 30 of the 1954-55 principals held either the required Administrative Principal's Certificate or the Secondary Principal's Certificate. They rated the value of the requirements for the certificates as preparation for the principalship at 3.3 and 3.2, respectively.

Despite the fact that the factor of human relationships permeated the work of the principals, little formal work in this field was noted on the transcripts or in the certification requirements for the principals.

## Professional Experience.

Oregon principals had held 15 different types of positions in education at some time and 8 different types of positions immediately prior to attaining the principalship. They reported an average of 4.5 positions in which they had spent 7.2 years in the pre-principalship experience. Most of this experience was in secondary teaching; yet, the principals rated the value of this position quite low as preparation for the principalship in the opinions of principals.

The principals reported a total of 16.6 mean years of experience in education, had spent 5.1 mean years in current positions, and had 9.4 mean years in 2 different secondary principalships.

## Budgeting the Principal's Time.

Recent literature in the field indicates that the principal's most important function is in the area of supervision and improvement of instruction. Oregon principals' concept of the principalship correlated highly (.93) with that of 29 authorities in the field. The correlation was made between the percentage of time which each group thought that principals should spend in each of thirteen categories of duties.

Generally, Oregon principals were not successful in spending their time as they thought they should. Principals in districts of the first class were the most successful; but the principals serving in a dual capacity as principal-superintendents had low correlations (.40 and .41) between the way in which they spent their time and the manner in which they thought they should.

A suggested criterion for the expenditure of the principal's time follows. A percentage of time listed for each of thirteen categories of duties is a mean computed from three factors: (1) opinions of the authorities; (2) opinions of the principals; and (3) how Oregon principals actually spent their time on the job.



Categories of Duties	Percentages of Total Time
Supervision of teachers and improvement of instruction	22.
Office routine	15.
Activity program	12.
Pupil personnel	11.
Public relations	7.
Teaching	7.
Administration of the plant	6.
Business management	5.
Professional meetings	5.
Superintendent conferences	3.
Cafeteria	2.
Transportation	2.

#### Comparative Status.

The Oregon principals of 1954-55 compared favorably with principals from other states in relation to salary, training and certification status, professional activities, and personal data.

Lower teaching loads, more principals with long term contracts, greater membership and activity in professional organizations, more formal training and higher certification requirements characterized the 1954-55 Oregon principal over his 1940-41 counterpart.

#### Recommendations

1. That efforts be made to increase the security and tenure of secondary principals in Oregon through longer term contracts.
2. That further study be given the problem of tenure in position of secondary principals.
3. That greater consideration be given by Oregon principals to the secondary principalship as a professional career.
4. That increased attention be given to raising salary standards of Oregon principals in light of recommendations of the National Association of Secondary-School Principals.
5. That greater efforts be made to attain the conditions in individual school situations that will enable secondary principals to fulfill their primary functions--supervision and the improvement of instruction.
6. That professional growth through writing for publication be stimulated among Oregon principals.
7. That efforts be made to broaden the professional reading programs of the principals.
8. That more Oregon principals secure some formal preparation at institutions of higher learning outside Oregon where other recognized authorities in the field might be teaching.
9. That study be made of the formal training of Oregon secondary principals in relation to the recommendations of the National Association of Secondary-School Principals concerning general and specific training programs.
10. That study be instituted with a view to thorough revision of certification requirements for Oregon principals.
11. That institutions of higher learning adapt some aspects of their training programs to better fit the needs of the principals.
12. That efforts be made to broaden the teaching and other professional experiential background of Oregon principals prior to entering the secondary principalship.
13. That all means possible be utilized to make Oregon secondary principals increasingly aware of a modern

concept of the principalship with respect to the relative importance of its various duties and functions.

14. That various aspects of the behavioral sciences be made a part of the formal training programs for Oregon principals due to the emphasis on human relationships found throughout the discharge of their various duties.

15. That principals be encouraged to study their own performance of duties through self-evaluation, time studies, and other feasible means.

16. That secondary principals adapt the suggested criterion for the budgeting and expenditure of their time on the job to individual situations and utilize it as a guide for the improved organizations and performance of their multiplicity of duties.

Microfilm \$2.75; Xerox \$9.60. 212 pages. Mic 58-5229

#### THE ACADEMIC SUCCESS OF TRANSFERS TO THE JUNIOR LEVEL AT THE UNIVERSITY OF COLORADO

(L. C. Card No. Mic 59-803)

Alfred Wallace Nall, Ph.D.  
University of Colorado, 1958

Supervisor: Professor Harl R. Douglass

The success of junior-college students after transfer to a four-year college or university has been a subject of continuing interest since the inception of the junior college in the early 1900's. The work of the transfer in the upper division when compared with that of the native or university trained student has been considered by many to be the crucial test of the preparatory function of the junior college. The general purpose of this study was to provide evidence as to the academic success of certain transfer students at the University of Colorado which would be useful to the administration in the development of educational policy and the preparation of plans for coping with the problems related to the oncoming expansion of higher education. The basic question which has been investigated in this study is: Do students who have received their lower-division preparation in institutions (junior colleges in particular) other than the regular lower division of the University of Colorado succeed as well academically in the upper division after transfer as the native students?

To obtain an answer to this question, the academic records of two groups of junior-college transfers--those from Colorado junior colleges (N--134), and those from out-of-state junior colleges (N--126)--and a group of four-year college and university transfers (N--221) to the junior level in the College of Arts and Sciences, the School of Business, and the College of Engineering were examined and compared with those of control groups of native University students. An attempt was made to equate the scholastic ability factor by matching the groups compared on the basis of sex and rank in high-school graduating class. The criteria for the evaluation of relative academic success were scholarship, as measured by grade-point ratios for four upper-division semesters, and persistency to graduation.

The junior-college transfer groups in the College of Arts and Sciences made significantly lower scholarship records in the first two upper-division semesters (those



persisting through the third and fourth semesters showed gradual improvement), were more heterogeneous, had fewer graduates, and thus on the whole were less successful academically than the matched native University students with whom they were compared. They also compared less favorably than the four-year transfers with their respective control groups.

The junior-college transfers to the School of Business were even less successful academically than were those in the College of Arts and Sciences, and did not equal the performance of the four-year transfers.

The junior-college transfer groups in the College of Engineering equalled or excelled their matched native groups in scholastic averages, but were considerably less successful in terms of the number persisting to graduation.

Variability in research design, technique, and criteria of evaluation make direct comparison between studies of this type of doubtful validity, but in general it would appear that junior-college transfers to the junior level of the University of Colorado were relatively less successful academically than those reported in a majority of the investigations related to this problem made in other colleges and universities. With the exception of the evidence as to highly successful scholarship in the College of Engineering, the findings of this study would tend to support the thesis that when carefully compared with native students, junior-college transfers to the upper division of the University of Colorado were academically less successful in both scholarship and persistency.

Microfilm \$3.30; Xerox \$11.20. 254 pages.

#### THE NATURE AND EXTENT OF PARTICIPATION IN THE INITIATION AND DEVELOPMENT OF WRITTEN POLICIES BY SELECTED GROUPS IN THE UNIVERSITY OF ILLINOIS HIGH SCHOOL

(L. C. Card No. Mic 59-574)

Robert Franklin Seaman, Ed.D.  
University of Illinois, 1958

The problem of this study was to determine the nature and extent of participation by various groups and individuals in policy making. As a corollary to this problem, a method of studying participation was developed and used in an actual school situation, the University of Illinois High School. The method of study included the collection of data which explored changes in the number and types of adopted policies, the groups or individuals who participated, the part of the policy making process in which they participated, and some measure of the amount of their participation. Only written adopted policies developed within a specified time and which satisfied the definition and criteria for policy selection were included. Participation was limited to the initiation and development aspects, including adoption, of policy making, and to selected groups and individuals.

By examining these data for trends in participation, conclusions were drawn as to the desirability of the assumed goals of participation, modifications of the method of study which would better adapt it to future use, and modifications which the school studied should make to improve participation in policy making.

The major findings, with respect to the extent of participation, were: (1) The staff raised the most issues for consideration, gave first consideration to the most issues, participated to the greatest extent, and adopted the most policies. (2) The students ranked close behind the staff in each phase of policy making. (3) When area and year were considered, the students sometimes had the highest participation, especially in the extracurricular area.

The major findings, concerning trends in participation, were: (1) During periods of rapid staff turnover, there was a greater feeling of need for policies and for increased participation in the development of policies on the part of the staff than when there were fewer staff changes. (2) Emphasis on and activity in policy making developed interest which led the groups to improve their policy making procedures.

Other trends were: (1) After a period of intensive participation and growing interest in policy making, groups designed to study problems and recommend policies as solutions were organized and policy making functions tended to be transferred from the larger group to smaller ones. (2) The nature of the problems for which policies were developed was associated with the number of policies which were adopted. (3) The extent of participation by any one group was not affected when aspect of policy making was considered. (4) The extent of participation by groups or individuals in the various policy areas differed according to their interest, responsibility, and authority in each area.

It was also found that: (1) The group who first considered an issue was usually the group who adopted the ensuing policy. (2) The group who first considered an issue was usually the same group who not only adopted the ensuing policy but who was most affected. (3) The group who was most affected by a policy, more often than not, participated in the policy's development.

The method of studying participation functioned well, but the findings indicate that: (1) The assumed goals of participation should be written to include the school board when the study is applied to public schools. (2) The method should include provisions for making value judgments as to the merit of participation.

Among the possibilities for further study are: (1) Based on the method used in this investigation studies should be made to establish standards for judging the value of varying degrees of participation. (2) Studies should be concerned with locating issues which were raised but never became policies. (3) The policy making aspects of execution and evaluation should be investigated.

Microfilm \$2.65; Xerox \$11.60. 201 pages.

#### SURVEY-CONSULTANCY IN OPERATION IN A UNION HIGH SCHOOL DISTRICT: A CASE STUDY

(L. C. Card No. Mic 59-245)

Raymond J. Simpson, Ed.D.  
Stanford University, 1958

##### Statement of the Problem

The purposes of the study are to describe the processes of a particular school survey and to determine through



logical analysis (1) the operational procedures involved in applying to the school survey the concept of the consultant as an outside, resource person promoting educational change and (2) the elements of the total operation which appear to condition the attainment of the objectives. The particular survey took place throughout the 1956-57 school year and employed a consultant team of fifteen persons.

#### Procedures

The research design of the study resembles the observational field work method with the investigator in the role of participant-observer as a member of the consultant group and in the capacity of coordinator of consultant activities. The study involves two basic research methodologies: (1) documentary descriptive report of a process and (2) logical analysis and synthesis.

The methodology of documentary description is utilized in presenting physical and historical data concerning the district under study and a journal account of the processes of the survey. Additional data for analyzing the processes are provided through structured interviews with consultant team members and selected district personnel. These interviews were conducted at the close of survey operations and are concerned with the perceptions of the various persons relative to the objectives, processes and outcomes of the survey.

#### Conclusions

The statement of the problem poses five specific questions regarding the processes of the particular survey. Answers to these questions are derived by the logical analysis of all data as follows:

Objectives of the survey operation.--A formal contract called for an appraisal of curricular and instructional practices primarily as bases for the construction of new school plants. Early survey activities revealed that many local persons expected a comprehensive, critical evaluation and specific recommendations independent of new construction. The consultants proposed to assist local persons in establishing a pattern for improvement and in developing understandings regarding the total educational enterprise. These latter objectives became more acceptable as the survey progressed.

Consultant roles.--The consultants generally considered themselves to be motivators to action and thinking and as resource persons and teachers.

Survey procedure.--Survey activities involving local persons were structured as potential learning activities which fostered interaction among all participants. Immediate perceived problems were utilized as studies in the development of larger concepts. Local responsibility was encouraged for the solution of local problems rather than too ready dependence upon consultant expertness. The final written report was re-statement of material presented verbally.

Observed behavioral changes indicative of attainment of objectives.--Sufficient specific changes in behavior were observed and reported by local persons to indicate a degree of success in attaining the objectives. Consultants did not observe changes to the same extent. A major accomplishment appeared to be positive growth in understandings.

Elements appearing to condition attainment of objectives.--In the early stages general agreement was not reached as to specific objectives. Only rather general agreements to work together were possible; more specific objectives and procedures emerged in later stages. Growth in understandings appeared to require a minimum period of time independent of the amount of consultant contact. The consultant role was not clear in the early stages, but later developments found the roles of motivator and resource person more generally accepted. The position of coordinator occupied a strategic position.

Major hypotheses for future research are: (1) implementation of survey findings will be dependent upon the degree of continued interaction among local school persons and (2) continued interaction among local persons will be dependent upon effective interaction facilitated during the survey.

Microfilm \$3.30; Xerox \$11.40. 256 pages.

#### EDUCATIONAL CHANGES ACCOMPANYING REORGANIZATION IN JEFFERSON COUNTY, COLORADO

(L. C. Card No. Mic 59-844)

Neal Herred Tracy, Ed.D.  
University of Colorado, 1958

Supervisor: Professor Calvin Grieder

This thesis reports an intensive study of the effects of school district reorganization in Jefferson County, Colorado, where the number of school districts was reduced from forty-two to one. The purpose was to determine the educational changes that accompanied reorganization and to evaluate those changes through comparison with the expectations and criteria for this particular reorganization as well as for reorganization in general.

The method employed the selection of a base year, 1947-48, and the reconstruction of the educational situation in Jefferson County in that year for comparison with the last year for which information was complete, 1956-57. Reorganization was accomplished with an election held May 31, 1950, and the premise upon which the study was based was that the reorganized district had been functioning long enough for educational changes, or directions of change, to have become established. Causal relationships, in which the act or condition of reorganization may be considered the cause, or part of the cause, of change, were also sought. Educational changes were considered in the areas of finance, administration, curriculum and co-curricular offerings and opportunities, and staffing of schools.

The act of reorganization resulted in a district adequate in total enrolment, moderately adequate--but not wealthy--in total valuation, and able to operate as a unit through the elimination of all previous district boundaries and district governing bodies and the election of a single board of education. The formation of the county unit gave the district the potential for change in the direction of expectations for reorganization. In the areas explored, the reorganized district has met or exceeded the expectations for reorganization and, with a few specific exceptions, has



shown a pattern of educational change roughly parallel to that found in other studies of reorganized areas.

Through the development of policy and practice, possible with the single board of education, equalization of educational opportunity for the pupils of the county is an accomplished fact within a few limitations inherent in the transportation of approximately one-fourth of the pupils. In addition, the educational opportunity exceeds that available to any student in any district of the county prior to reorganization, although four districts were operating twelve grade programs prior to reorganization that were nearly equivalent to the present situation.

More specifically, administrative structure has been developed to provide added services and to employ the services of specialists for more effective function; the teaching staff has been upgraded in terms of educational level, certification, reduction in the number of teachers holding substandard credentials, and employment of specially trained personnel for instruction in art, music and physical education; curricular and co-curricular offerings have been extended in established fields and additional fields of study have been added; and certain financial changes relating to such factors as total valuation and uniform levies for school purposes have resulted in a high degree of flexibility in the provision of school facilities and the allocation of monies for school operation without regard to local abilities.

On the negative side, the reorganized district does not appear to have realized its potentiality in uses of transportation facilities, equalization of class sizes and provision of school facilities. This is due, in part, to the continued low per pupil valuations and to the rapid growth of school enrolments which have more than doubled since reorganization. The rapid growth has also been a factor in educational change and an influence in public acceptance of reorganization and avoidance of some of the difficulties which may accompany reorganization.

Microfilm \$4.35; Xerox \$14.60. 338 pages.

#### A COMPARISON OF CERTAIN ASPECTS OF THE DEVELOPMENT OF PUBLIC EDUCATION IN ILLINOIS, UNITED STATES OF AMERICA AND NEW SOUTH WALES, AUSTRALIA

(L. C. Card No. Mic 59-595)

William George Walker, Ph.D.  
University of Illinois, 1958

Educational organization and administration are products of the total culture in which they develop. In Illinois, where the history of government reflects an emphasis on decentralized control, education became a function mainly of the local districts. In New South Wales, which developed from quite similar cultural origins during the same historical period, the history of government reflects a desire for centralized control of the public schools. Local control in Illinois has led to problems of efficiency, economy and achievement of equal educational opportunity, though a wider interest in central control has developed in recent years. Centralized control in New South Wales has resulted in problems of undue conformity, mediocrity and lack of adaptability.

The financing of Illinois schools has reflected the unequal resources of the school districts. Adoption of the "foundation" program as a consequence of the new interest in state financing of education has made this problem less pressing, but all educational expenses have not been covered by the program. In New South Wales, where finance is chiefly drawn from federal income tax receipts, considerable equality of educational opportunity has been achieved, although expenditures have usually been inadequate.

Illinois curricula reflect the part played by teachers, parents, accrediting agencies and other organizations in developing programs adaptable to local needs, while in the Australian state the curricula reflect the prescriptive attitude of the school inspectors, and, in the high schools, the strict academic tradition of the University of Sydney.

Supervision of Illinois Rural Schools was chiefly the function of the County Superintendent until 1946, when this function became primarily the responsibility of superintendents appointed by the new consolidated districts. While the state plays a growing role in supervision, there is still room for the services of a reconstructed county office. In New South Wales an inspectorial system introduced in the nineteenth century has imposed an undesirable conformity upon the schools, although it has provided an effective method of assessing teachers' efficiency.

The Illinois teacher, typically a female, has rarely been as highly regarded as the typically male Australian teacher. The Illinoisan receives a comparatively lower salary, works for a shorter period each year, often has a second job, and has a higher professional mortality rate. The New South Wales teacher appears to be supported by a more effective teachers' organization, and to enjoy greater public respect, though he has tended, because of his isolation, to become too complacent about his schools.

The New South Wales system has long been noted for its efficiency and economy, but also for its lack of flexibility and adaptability. Attempts have been made to correct this through the establishment of area directorates. At the same time, the Illinois system, though very adaptable and flexible, has sought to improve its efficiency and economy by increasing the size of school districts and centralizing some services. Each state is attempting to find a judicious balance between centralized and decentralized procedures.

Large-scale change appears quicker and more thorough in the centralized system, though once established it lacks the internal flexibility observed in Illinois. While the power of the individual over educational change seems to be declining, in either state he can still play a significant role as an influencer of public opinion.

From Illinois, New South Wales can learn much, including the development of local interest in schools, supervision rather than inspection of teachers, requirement of administration courses for executives, promotion upon ability rather than seniority, payment of additional salary to outstanding teachers, and a longer period of training for elementary teachers. From New South Wales, Illinois can learn to share its wealth equally for educational purposes, to use professional taxation assessors, to centralize some supervisory and service functions, to lengthen the school year, to divorce politics from education, and to develop a stable profession of full-time teachers.

Microfilm \$3.55; Xerox \$12.00. 273 pages.



**A STUDY OF SOME PROBLEMS EXPERIENCED  
BY BEGINNING TEACHERS IN THE  
NORTH CAROLINA PUBLIC SCHOOLS**

(L. C. Card No. Mic 59-66)

Joseph Harding Wishon, Ed.D.  
The University of North Carolina, 1958

Supervisor: Guy B. Phillips

The study analyzes and describes the problems reported by 122 beginning teachers who answered a questionnaire submitted to a group of beginning teachers selected at random from the North Carolina public schools in March, 1956. The factors that influence the status of beginning teachers are shown, and the status of the teachers in the study is compared with the status of beginning teachers over the nation. The problems of eighteen classifications of teachers within the total number of teachers in the study are compared. The problems in ten areas of experience are described.

Some of the conclusions are: the problems experienced by beginning teachers are of greater importance than administrative and supervisory personnel recognize, there is not a great amount of difference in the number of problems experienced by teachers compared on the basis of such factors as training, sex, marital status, and environmental home background.

Some recommendations resulting from the study are: a comprehensive general education should be continued as the basis for teacher education, a period of continuous actual teaching experience and observation of good experienced teachers should be a primary element in the education of teachers, and more opportunities should be provided for beginning teachers to learn local school plans and policy before the school year begins.

Microfilm \$3.10; Xerox \$10.60. 240 pages.

**EDUCATION, ADULT**

**THE RURAL COMMUNITY AND ITS  
"DEVELOPMENT" IN THE ARAB WORLD**

(L. C. Card No. Mic 59-684)

Mounir Habib Khoury, Ph.D.  
Cornell University, 1958

The central theme of this study deals with the basic problems of change and development in the Arab village. Some of these problems are inevitable consequences of the transitional stage through which the Arab World is going today. Other problems are results of the introduction of a number of developmental programs and activities, most of which are directed toward the solution of such chronic ills as poverty, ignorance, disease and superstition.

The main objectives of this study are twofold: first, to examine the relative effectiveness of some of the existing Rural Development programs in the Arab World; second, to gain a better understanding of the problems of

change and development that confront the changing rural community in the Arab World today.

For the achievement of these objectives, the study is divided into two principal parts. Part I sets the stage by briefly discussing the geographic and historic background of the so-called Arab World. Following this historico-geographic presentation a chapter is devoted to the discussion of the Arab village community as it exists today; special emphasis is laid upon the basic themes and values held by the Arab rural peoples.

The second part of the study deals with three major approaches to rural development, widely used in the Arab World. These are: the Social Center approach which has grown and developed in Egypt; the Extension Service approach of the United States; and the new approach widely known as Community Development. Since all of these three concepts are relatively new to the Arab World it is difficult to study their merits and demerits on the basis of their accomplishments or lack of such; therefore they are studied in terms of their approaches rather than in terms of their successes or failures.

Regarding the first approach, the Social Center, the study sketchily traces the history and development of this institution to the present time and discusses the way in which it renders its services to rural people. It is very interesting to note that despite its many weaknesses and pitfalls, the Social Center has become a cultural reality to Egypt, and its roots are firmly anchored in the Egyptian soil.

With respect to the Extension approach, this American product has spread more widely over the Arab World than any other rural development program. However, Extension has not been accepted unconditionally by any of the Arab States; many modifications and adaptations have been made. It has been used, for example, as a uni-functional activity and not as a multi-functional one; agriculture alone constitutes its nucleus and not a combination of agriculture, home economics and youth clubs (4-H) as in its place of origin, the United States. Some of the main obstacles to the further growth of Extension in the Arab World are also discussed in this study.

Community Development, the third approach, is gradually taking root in the Arab cultures. No Arab country has, so far, adopted this concept either fully or even partially; all Community Development programs are undertaken on a small experimental basis either by national governments or by private organizations. The lack of any clear-cut definition of Community Development seems to be one of the main causes for its slow progress in the Arab World. Unlike the Social Center and the Extension concepts, Community Development has no specific objective; its method is to "start where people are" and to respond to their "felt needs." Such a fluid philosophy is not as easily understood as are the philosophies of Extension and the Social Center.

In conclusion, the following points seem to be paramount with respect to their implications for the future of Rural Development in the Arab World.

1. The most effective decision-making unit in the Arab rural areas remains the "primary group" namely, the family, the tribe or the village community.

2. There is a genuine concern in the Arab World to uplift the farmer from his "misery." However several obstacles stand in the way of these difference developmental programs, be they Social Centers, Extension or Community Development. The two majors ones are:



- (a) the problem of anchoring these developmental programs in the cultural life of the rural population, and
- (b) the problem of finding a stable economic basis to insure their permanency.

3. Arab leaders are strangers in their own culture. Communication between them and the masses of the rural population is difficult on account of basic differences between the modes of life of the two groups.

4. The general tendency among Arab governments is to engage in huge developmental projects - projects that are manifest, impressive and monumental.

5. The predominance of the spirit of nationalism seems to be both an asset and a liability, depending on how this spirit is treated. Many projects of Rural Development have been destroyed by this rising tide of nationalism, while others are being bolstered and encouraged by it.

6. The Arab village remains relatively isolated, both physically and socially; this handicaps its progress and development. A good network of roads and other communicative facilities whereby the villager is put in touch with the outside world is a pre-requisite of any sound and permanent development.

Microfilm \$2.40; Xerox \$8.40. 183 pages.

## EDUCATION, HISTORY

### AN EXAMINATION OF THE CURRENT RELATIONSHIP BETWEEN RELIGION AND AMERICAN PUBLIC SCHOOLS

(L. C. Card No. Mic 59-793)

Richard Bruce Dierenfield, Ed.D.  
University of Colorado, 1958

Supervisor: Professor Homer P. Rainey

One of the most current and vexing problems facing American public education is the place religion should be given in the tax supported school. The First and Fourteenth Amendments have outlawed any infringement of religious liberty or establishment of religion. The public schools have therefore been cautious about dealing with religion. Following World War II a renewed interest in religion has brought about increased pressures from denominational groups for the inclusion of more emphasis on religion in the schools. During this period also a number of important legal decisions have affected the status of religion and public education. The problem investigated in this thesis deals with the present status of the relationship between religion and the American public schools. Since the situation is changing at the present time an examination of the current status of the relationship can provide information which will assist in a better understanding of the issue.

The methods used to study this problem have varied depending upon the nature of the evidence available. Each area of the issue involved a somewhat different approach. The history of the relationship was reviewed by analyzing the important documents involved, and through reading historical interpretations by scholars in the subject. The legal ramifications were drawn from laws on both the state

and national levels, as well as the decisions of Federal and state courts. In an effort to learn present practices used in public schools to handle religion the available national surveys were consulted. In addition pertinent educational literature was read, letters from school authorities describing their practices were studied, and published material from many school systems was analyzed. The problems arising from efforts to deal with religion in public schools were investigated by examining national studies, statements of policy by church groups, and by reading relevant religious and educational literature. The parochial school movement and its relation to public education was studied through surveys, policy statements of church bodies, and opinions of authorities in the field. Proposals for solving the problem were obtained from material published by church organizations, educational groups, and descriptions of experimental programs being carried on in various school systems.

The analysis of the current relationship between public education and religion points to a number of conclusions and trends. Some of the conclusions which seem warranted are these:

1. The issue of where religion fits into the public schools is of widespread and current interest.
2. A great variation exists among schools in their policies regarding religion.
3. Sectarian groups are pressing for more religious emphasis in public education.
4. Substantial growth has occurred in both Catholic and Protestant parochial schools in recent years.
5. The question of tax support for parochial schools is one of intense controversy and variation in practice.
6. A wide difference of opinion exists among the three major faiths regarding a solution to the problem.
7. Factual information on many aspects of the relationship between public education and religion is not available.

A number of trends seem discernible from the study.

1. The controversial nature of the issue will not diminish and the courts will be asked to decide many cases involving the subject.
2. The "released time" approach seems to be growing in popularity.
3. The factual, "teaching about" religion appears to be attracting more adherents.
4. The Roman Catholic Church will continue to press for financial aid for its parochial schools from tax funds, both local and national.
5. An increase in the emphasis on religion in teacher education will take place.

The present state of the relationship can be summed up in three words: interest, controversy, and experimentation. The two most important ingredients in the medicine which will cure this problem are time and charity. If a solution is pursued by all in a spirit of understanding and patience, the prospects for success will be immensely heightened. Microfilm \$5.20; Xerox \$18.20. 405 pages.



THE DEVELOPMENT OF SELECTED  
ASPECTS OF HOME DEMONSTRATION WORK  
IN THE UNITED STATES

(L. C. Card No. Mic 59-681)

Claire Erin Gilbert, Ed.D.  
Cornell University, 1958

Home Demonstration work is a part of a nation-wide educational program for rural people, known as Cooperative Extension Work. Agriculture and 4-H Club Work are other phases of this program. The home demonstration program developed as an educational agency operating in the subject matter area of home economics. Its benefits were intended primarily for homemakers who were engaged in the task of improving personal, home and family living.

The purpose of this study was to describe, in historical context, selected aspects of the home demonstration program as it has developed in the United States. The aspects were: the educational function, the subject matter area, the objectives, and the clientele of home demonstration work.

The study was designed to answer these questions: (1) What were the foundations and framework of Cooperative Extension Work? (2) What were the significant developmental periods in the history of the home demonstration program? (3) What was the scope of the program in the 1950's? (4) What trends were identifiable in the developmental process? (5) What will be the probable nature of the home demonstration program in the future?

The historical method was used in seeking answers to questions regarding the specific aspects and objectives of the study. Official documents, including significant written records, research reports, historical accounts and important speeches by responsible people in the field of Extension Work were examined. The most significant periods in the development of home demonstration work included the origins, the development from 1914 to 1950, the scope in the 1950's and the probable future of home economics extension work.

The kind of educational program envisioned as assisting rural people in solving their problems of daily living became a reality when the Congress enacted the Smith-Lever Law in 1914. The home demonstration program was established to meet the needs and interests of homemakers. Its working objectives, content and methods have remained flexible enough to change as the situation indicated that adjustments were advantageous.

Through more than forty years home economics extension has rendered service to an ever-widening audience. The staff has increased in number and in professional preparation. Their efforts have helped materially in translating scientific information into improved daily living for millions of families in every State.

The vision of improved living, that gave birth to home economics extension work and that has guided its development in the increasingly complicated milieu of the past forty years, points to a future of expanding educational opportunities. Microfilm \$2.70; Xerox \$9.40. 208 pages.

THE ORIGIN OF MILITARY SCHOOLS IN THE UNITED  
STATES FOUNDED IN THE NINETEENTH CENTURY

(L. C. Card No. Mic 59-62)

Lester Austin Webb, Ph.D.  
The University of North Carolina, 1958

Supervisor: Arnold K. King

The origin of military schools in the United States founded in the nineteenth century is presented as a military school movement with four aspects. These are: first, the national military school movement; second, the state military school movement; third, the private military school movement; and fourth, the denominational military school movement.

The "National Military School Movement" embraces the steps leading to the establishment of the United States Military Academy at West Point, New York, and attempts between 1820 and 1850 to abolish this institution; attempts to establish additional schools similar to the Military Academy at West Point; and the change in the policy of the Federal Government following the Civil War with respect to this movement and its connection with other military school movements. Schools established by the government, generally classified as Army service schools and post schools, are not included in the national military school movement.

The "State Military School Movement" embraces the establishment of state military schools; state aid to private and denominational military school movements; and acceptance by the states of Federal aid involving military education and training in state educational institutions.

The "Private Military School Movement" includes founding or establishing purely military schools under strict military organization, government, and discipline at all times; semimilitary schools where the military organization, government, and discipline existed to a lesser degree than in purely military schools, and where military education and training were compulsory for some and optional for others, or optional for all students; military departments established in educational institutions with military education and training compulsory for some and optional for others, or elective for all; and schools offering military subject matter courses, as in the beginning of the movement.

The "Denominational Military School Movement" includes founding or establishing military schools and departments on collegiate and secondary levels similar to those described under the private military school movement.

The primary purposes of this dissertation are: first, to trace the origin and show the growth and development of the military school movement in the United States during the nineteenth century; second, to bring together materials which show the scope of this movement as it developed along national, state, private, and denominational lines; and third, to present a general survey which it is hoped may spur others to dig deeper into the history of military education, a field hitherto ignored and neglected by educational historians.

The secondary purpose of this dissertation is to sift long neglected materials for evidence of the underlying reasons for the establishment of military schools and to focus this evidence on the charges that the movement,



particularly in the South, was militant and, prior to the Civil War, a preparation for that war.

Included in this survey are: schools where subject matter was the only military feature; purely military schools; semimilitary schools; and military departments, whether in state, private, or denominational educational institutions. A limitation lies in the number of private and denominational military schools and departments considered, and no attempt has been made to go beyond the origin or source, rise, growth, and development of the four aspects of the movement. It is not intended to present a history of any institution. Microfilm \$3.85; Xerox \$13.00. 297 pages.

# A CRITICAL STUDY AND ANALYSIS OF THE UNIVERSITY OF MINNESOTA SCHOOLS OF AGRICULTURE

(L. C. Card No. Mic 59-1310)

Bernard Edward Youngquist, Ph.D.  
University of Minnesota, 1958

Advisers: Clifford P. Archer, Ph.D.; and  
Milo J. Peterson, Ph.D.

## Purpose

The research was conducted to study and analyze the current role of the University of Minnesota Schools of Agriculture and to thereby test the working hypothesis that "other educational agencies are assuming this role as currently described."

## Procedures

The problem was studied with reference to past and current historical trends for these schools, to the parent population served, and to the current status of agriculture, the population, and other educational services. Data on the parent population was based on an 86% response to a survey mailed to 900 families in 76 counties. Data on the historical trends, current status, and regional characteristics was gathered from official University of Minnesota and state governmental data, and from official public school and college registrar records.

## Findings

1. The current role of the University of Minnesota Schools of Agriculture is a supplementary, secondary-level education serving farmers.
2. The Schools of Agriculture in Minnesota are unique in that growth and service at the secondary level has continued to the present day, they remain as regional arms of a land-grant college, a six-months' term prevails, parental homes are well distributed over each region, farmers use these schools, and the total enrollment has been near or over normal capacity for the past decade and is now 84% boys.
3. There is no need for similar schools of agriculture in Minnesota.
4. Follow-up studies indicate that approximately one-third of the male graduates enter farming directly. An

increasing number of graduates are going into higher education.

5. The enrollment at the subcollegiate post-high school terminal curriculum at St. Paul has declined. Similar schools at other land-grant colleges have closed with one or two exceptions.

6. In the United States, 60% of the 90 special Schools of Agriculture studied are closed. The remaining 37 schools are 5% terminal subcollegiate schools of agriculture, 7% combination two-year and four-year colleges, 18% secondary schools of agriculture, 21% four-year colleges, and 49% junior college-level technical schools or junior colleges.

## Conclusions

The prevailing role of the regional Schools of Agriculture is being assumed by the public high schools.

The evolving role for the regional Schools of Agriculture will probably be a junior college-level technical school with a curriculum geared to a farmer who must increasingly feed more people and who needs more knowledge and more skills. The farmer of the future needs training in the liberal arts as well as the technological arts. This evolving role will project increasingly to include the rural nonfarm population. Collegiate service is probable in some areas.

The future role of the regional Schools of Agriculture should remain an arm of the University and this role must fit into the total context of higher educational service in the particular region.

The evolving role for these regional schools is likely to be nearly parallel for the West Central and the Northwest Schools of Agriculture. The North Central School and the Southern School are likely to be somewhat different from each other and definitely different from the Northwest and the West Central Schools.

The region served by the Northwest School of Agriculture needs an agriculturally oriented, college-level, technical school.

A pilot study should be launched as soon as possible at one of the regional schools to test the technical curricula idea on an extended basis.

The remaining subcollegiate terminal vocational curricula in agriculture in Minnesota and in other states should be dropped. Collegiate-level curricula which is directed towards farm operation needs exploration and pilot study.

Microfilm \$4.35; Xerox \$14.60. 337 pages.



## EDUCATION, PHYSICAL

**MEASURING AND SCORING SELECTED  
ENVIRONMENTAL FACTORS THAT  
AFFECT THE PHYSICAL HEALTH OF  
ELEMENTARY SCHOOL CHILDREN**

(L. C. Card No. Mic 58-7609)

Edward Bonner, Ed.D.  
University of Utah, 1958

Chairman: Dr. Samuel J. McLaughlin

### I. STATEMENT OF THE PROBLEM

The primary purpose of this dissertation was to develop measuring and scoring instruments by which selected environmental factors that affect the physical health of elementary school children could be measured and scored.

A major sub-problem was to test the developed measuring and scoring instruments for useability and reliability.

### II. DELIMITATIONS

In 1953 the Joint Committee on Health Problems in Education of the National Education Association and the American Medical Association classified health problems under three divisions. These divisions were: (1) School Health Services; (2) School Health Education; and (3) Healthful School Living.

This dissertation was delimited to a study of selected environmental factors in that phase of Healthful School Living that affect the physical health of elementary school children. These factors were: 1. Classroom Seating. 2. Classroom Heating and Ventilating. 3. Classroom Lighting. 4. Classroom Housekeeping. 5. Classroom Chalkboards. 6. School Health Suite. 7. School Lavatory Rooms. 8. School Water and Plumbing Facilities. 9. Classroom Space.

### III. PROCEDURE

Before measuring and scoring instruments could be developed it was necessary to obtain pertinent information and opinions from leaders in the various phases of school building construction and maintenance, manufacturers of school equipment, school administrators, educational consultants, students, teachers, faculty members of several universities, and professional organizations. The method employed in obtaining this information was by interview and correspondence. Important information was also obtained from educational and other literature.

The instruments were then developed and placed in the hands of scorers with varying amounts of experience in the use of measuring and scoring tools. The scores were: (1) eighty-one university students; (2) six elementary school principals; and (3) the author of this study. Each scorer, with the exception of the author, measured and scored one elementary school building. The author measured and scored six buildings. The buildings were classified as: (1) new schools; (2) old schools with recent extensive remodeling; and (3) old schools with very little remodeling.

The measuring and scoring results were evaluated to determine the useability and reliability of the two instruments.

### IV. FINDINGS

The following findings were arrived at through a series of statistical analyses.

1. University students measured and scored with consistency.

2. The measuring and scoring of principals and author showed substantial reliability.

3. The scores given by the author were lower than the scores given by the university students and the principals.

4. The median rank-difference correlation among raters' percentage scores for each factor of health from school to school was greater than the median of rank-difference correlations among raters' percentage scores within a school for the nine factors of health.

5. University students rated the health factor of Classroom Space more consistently from school to school than any other factor. Classroom Heating and Ventilating was the least consistently scored factor from school to school.

6. No scorers had difficulty in the use of the criteria and the score card.

### V. CONCLUSIONS

The conclusions of this study are listed below. These are based upon the findings that were previously presented.

1. Relatively inexperienced scorers can use the two instruments with considerable consistency.

2. The greater the experience of the scorers, the greater the reliability of the ratings.

3. The more experienced raters tend to give lower ratings.

4. The consistent scoring of the nine selected health factors within a school is more difficult than the consistent scoring of a given factor from school to school.

5. Some factors are more consistently scored than other factors.

6. The directions are clear enough so that the instruments can be used by relatively untrained scorers without difficulty.

7. The statistical analyses indicated that the two instruments are both reliable and useable.

Microfilm \$2.10; Xerox \$7.40. 157 pages.

### A VISUAL AID FOR THE TEACHING OF BEGINNING MODERN DANCE IN HIGH SCHOOLS

(L. C. Card No. Mic 58-5807)

Lolita Dinoso Carter, Ph.D.  
State University of Iowa, 1958

Chairman: Associate Professor Lorena Porter

The purpose of this study is to develop a modern dance film for use of teachers of dance in high schools. The film is designed to motivate interest in dance among high school students by showing typical experiences of a beginning high school modern dance class.

The opinions of selected college dance experts and high school dance teachers, a review of current literature on the subject, and the writer's experience in teaching dance determined the materials and methods of approach included in the film. The use of the exploratory method of approach



to movement experience and problem solving as an approach to elementary dance composition were favored by these sources. The importance of relating the dance experience to the needs, interests, and goals of high school students was also indicated. The main part of the film consisting of the experiences of a beginning high school modern dance class is preceded by an introduction pointing out the nature and values of modern dance. In the selection of activities to be shown in the film, care was taken to select those which had motivational appeal. The content of the film and its execution were appraised by specialists for accuracy of content and technical quality.

Experienced dancers from the State University of Iowa were selected for parts of the introduction while the subjects for the body of the film were students from the University High School who had had little or no dance background. The writer worked with the high school group for a period of approximately five months prior to the actual filming schedule. Class meetings lasted for an hour once a week. Dance experiences included exploration of fundamental locomotor and body movements, variations and combinations of these movements, and elementary dance composition. In the latter, the students were encouraged to work individually as well as in groups. Some of the students' dance studies were later included in the film.

The Motion Picture Production Bureau, State University of Iowa filmed the project. A special set representing a dance studio was constructed. All filming except for a few outdoor scenes was done in this special set. The filming sessions lasted for two hours every day for two weeks. Maximum use of time was made possible by careful pre-planning of all scenes. Workprints were made available for viewing in a few days and unsatisfactory scenes were re-taken immediately.

The writer and the University cinematographer collaborated in editing the workprint. Two members of the staff of the Department of Physical Education for Women, State University of Iowa viewed the edited workprint for comments and suggestions. The narration was cued by running the picture through a moviola viewer. Percussion and improvised piano accompaniment for some of the scenes were recorded on magnetic film to match the action of the picture. A temporary narration was recorded to accompany the picture and musical accompaniment. The film was once again viewed by members of the staff of the Department of Physical Education for Women and some graduate students. The final narration was recorded after some changes, based on suggestions of the viewers, were made. The original negative was edited by the University cinematographer. A film guide was constructed to accompany the film.

In the construction of the film, much difficulty was encountered in synchronizing the percussion and musical accompaniment with the picture. The writer believes that the difficulty could have been avoided if all accompaniments were recorded beforehand and played simultaneously with the action during the filming period. The selection of more skilled students who could produce the desired movements and the inclusion of more interesting activities especially dance studies could improve the motivational appeal of the film.

The usefulness of the film as a motivating device can be tested only through its use with the groups for which it was designed. Microfilm \$2.00; Xerox \$4.20. 76 pages.

# THE EFFECTS OF PHYSICAL TRAINING UPON THE TOTAL SERUM CHOLESTEROL LEVELS IN ADULT MEN

(L. C. Card No. Mic 59-515)

Lawrence Arthur Golding, Ph.D.  
University of Illinois, 1958

**Purpose** To determine the effects of a hard endurance exercise program on the total serum cholesterol levels in adult men.

**Method** About 10 ml. of basal blood was collected from the median cubital of each subject about the same time each morning. None of the subjects were in any state of stress due to exercise, infection, or undernutrition. In none, was the collection of a sample preceded by physical exertion or exposure to extreme heat or cold.

The Modified Bloor, Pelkan and Allen<sup>1</sup> method for the determination of cholesterol was used in this study. The standard error of measurement for the cholesterol determination procedure was  $\pm 0.53$  on the Transmittance Scale.

Four male subjects were tested for total serum cholesterol prior to any exercise. In the beginning the cholesterol determinations were made over a period of ten days to establish a mean initial value and to determine the amount of daily fluctuation of serum cholesterol within the individual. The subjects were also tested on a variety of physical fitness items and various body measurements.

The subjects then participated in a twenty-five week training period of hard all-out endurance type activities. The subjects met for group workouts for one hour per day for five days a week and participated in an active recreational activity on the sixth day. When the subjects were unable to meet as a group, individual make-up programs were assigned to be done, so that no break in the training period occurred.

After the twenty-five week training period, subjects were again tested in a manner similar to the pretraining period.

The significance of change between the total serum cholesterol levels before and after exercise was treated statistically by the "t" test for the difference between two means.

**Results** Hard endurance exercise readily reduced the total serum cholesterol levels in the four experimental subjects. The changes in cholesterol levels for all experimental subjects were statistically significant at the 1% level of confidence. The controls did not change significantly during the study.

When the raw scores were converted to standard scores, many of the physical fitness improvements paralleled the improvement (i.e. reduction) in cholesterol. This similarity in the improvement scores tends to indicate that total fat, adipose index, specific gravity and percent of fat change in a similar manner to cholesterol.

The similarity of standard score improvements is also noted in post-exercise diastolic blood pressure, time of all-out treadmill run at 10 mph (8.6% grade), five minute step test and breath holding. This similarity of improvement indicates that as an individual improves his cardiovascular condition, he also lowers his total serum cholesterol.



It is readily observed that the trend in the data shows that the lowering of total serum cholesterol is proportional to the intensity and duration of the exercise. The harder and longer the subject worked the more the total serum cholesterol was reduced.

**Discussion** Although very little is known about cholesterol metabolism, it appears that exercise effects liver function and adrenal secretion which in turn increase cholesterol metabolism.

It appears that cholesterol behaves much as fat does as far as the effect of exercise is concerned, as can be noted in the similarity of changes between cholesterol and body measurements related to fat (total fat, adipose index, specific gravity, percent of body fat). The hypothesis that may be presented is that as excess fat tissue is metabolized through exercise, that is exercise hard enough to be beyond the daily caloric intake, so too is cholesterol metabolized.

The lowering of total serum cholesterol levels in each subject was accompanied by a proportional increase in basal metabolic rate. This agrees with other studies done on cholesterol and basal metabolism.

Microfilm \$2.70; Xerox \$9.20. 205 pages.

1. John A. Kolmer, Fred Boerner, Approved Laboratory Technique, D. Appleton Century Company, New York, Fifth Edition, 1948.

# A STUDY OF PREDICTIVE EFFICIENCY OF SELECTED MENTAL AND MOTOR MEASURES AND SUCCESS IN ATHLETICS

(L. C. Card No. Mic 59-1285)

Gareth Raymond Olson, Ph.D.  
University of Minnesota, 1958

The purpose of the study was to identify which of several selected factors were sufficiently associated with success in athletics for senior high school boys to be helpful in recognizing potential athletic ability. Boys from the tenth, eleventh, and twelfth grades in two Minnesota high schools constituted the samples for the study. Eight measures were selected for special analysis: the McCloy Classification Index, the Sargent Jump Test, the Ten Second Squat Thrust Test, the Iowa-Brace Test, the McCloy General-Motor-Capacity Test, the Keller Quickness of Bodily Movement Test, the Otis Mental Ability Test and grade point average.

The boys were divided into three athletic ability groups for comparison purposes: an athlete group comprised of boys kept on squads, a rejected athlete group consisting of boys dropped from the squads, and a non-athlete group involving boys who never tried out for an athletic squad. The athlete group was further subdivided into high, average, and low athletic rated groups as identified by coaches. Null hypotheses were specified to test differences among both the athletic ability groups and the athletic rated groups on the selected factors. Current methods of

statistical treatment were used in the testing of these hypotheses.

## Findings:

1. The McCloy Classification Index was of little value in differentiating between athletic ability groups and athletic rated groups.
2. The Sargent Jump Test as a method of measuring leg power proved to be an effective means of differentiating between both athletic ability and athletic rated groups.
3. The Ten Second Squat Thrust Test differentiated between the athletic ability groups, but failed to differentiate significantly between the athletic rated groups.
4. As a measure of motor educability the Iowa-Brace Test showed inconsistent findings for the different grade levels between athletic ability groups and showed no relationship with athletic rated groups.
5. Combination of the previous four tests into the McCloy General-Motor-Capacity Test showed significant differences both between the athletic ability groups and the athletic rated groups.
6. The Keller Quickness of Bodily Movement Test differentiated significantly between groups identified by athletic ability, but showed no difference between the rated groups.
7. As a measure of intelligence the Otis Mental Ability Test was not useful as an instrument for differentiating between groups neither for athletic ability nor rated ability.
8. None of the analyses for grade point average showed a significant relationship with the athletic ability groups or the athletic rated groups.

## Conclusions:

1. The most useful factor for determining probable success in athletics as identified in this study was general-motor capacity as a measure of basic motor performance. The second most useful measure for this purpose was quickness of bodily movement. Other factors sometimes helpful in identifying potential athlete ability include leg strength and explosive power as measured by the ability to jump vertically and agility as measured by speed at which squat thrusts were performed.
2. Among factors of little or no usefulness in identifying potential athletic ability were maturity as measured by age, height and weight; motor educability as measured by the ability to execute a selected number of stunts correctly; intelligence as a measure of mental ability and grade point average as a measure of achievement.
3. An attempt to classify boys as athletes or non-athletes on the basis of test scores was sufficiently promising to indicate that further work along these lines should be undertaken. Further research in the area of general motor ability, its relationship



to probable success in athletics and to differentiate levels of ability needed in the different sports, is also recommended.

Microfilm \$2.80; Xerox \$9.60. 214 pages.

#### RELATIONSHIPS BETWEEN PHYSICAL FITNESS AND PSYCHOLOGICAL VARIABLES

(L. C. Card No. Mic 59-599)

Harold Park Wells, Ph.D.  
University of Illinois, 1958

**PURPOSE** To determine the relationships between physical fitness and psychological variables of male college students, aged 18-28.

On many of the physical fitness tests administered to children, high school and college students, and middle-aged people, perhaps some psychological variables will influence the test results. If one can determine what correlations there are between physical fitness and personality factors, then perhaps one can understand the mind - body relationships more clearly, and also interpret fitness tests more fully.

**RESEARCH METHODS** A sample of 80 University of Illinois male subjects were administered a battery of tests in the Physical Fitness Laboratory, and a series of objective and questionnaire tests in the Laboratory of Personality Assessment and Group Behavior.

The Physical fitness tests included measures of cardiovascular-respiratory and motor fitness and appraisal of physique. A total of 38 variables were obtained from the various fitness tests, which included: Basal Metabolism, Schneider Test, Electrocardiogram, Heartogram, Body measurements, Strength test, Vital Capacity, Larson C-VJ-D, Cureton 18 Item, and All-out Treadmill Run.

A total of 113 different objective, questionnaire, rating, and environmental condition variables, administered by technicians in the Psychology Department, were used to measure the many aspects of personality. These variables included Cattell's Sixteen Personality Factors; assessments of overall anxiety level, made independently by two psychiatrists, in interviews with all subjects; and other variables too numerous to be included in this report. A factor analysis was performed on the 113 variables, and 15 factors were determined.

35 psychological variables were correlated with the 38 physical fitness variables. The 35 psychological variables included Cattell's Sixteen Personality Factors, the 15 factors obtained from the factor analysis, the two psychiatrist's ratings, and 2 questionnaire tests on friends.

**RESULTS** There were 1,330 correlations determined using the product moment formula, with the use of IBM punch cards and an electronic digital computer (Illiatic). There were 116 significant correlations obtained between the physical fitness and psychological variables. A correlation (r.) that exceeded  $\pm .217$  was significant at the .05 level, and an r. that exceeded  $\pm .281$  was significant at the .01 level of confidence, according to Fisher's Tables.

Physical Fitness Variable (High Score)	Correlates With:	Psychological Variable (r. given in parentheses)
Biceps	More:	Adventurous (.329)
Girth	Less:	Overall Anxiety (-.290)
Total	More:	Critical Exactness (.349)
Strength	Less:	Non-conforming (-.272)
Larson's C-VJ-D	More:	Calm (.271)
	Less:	Anxiety (-.314), Tense (-.231)
Cureton's 18 Items	More:	Neural Reserves (.239)
	Less:	Anxiety (-.268)
Treadmill Run Time	More:	Passivity (.238)
	Less:	Tense (-.244)
Systolic Amplitude	Less:	Sensitive (-.240), Decisive (-.224)
Sitting Pulse Rate	More:	Overall Anxiety (.327)
	Less:	Inhibition (-.256)
Schneider Index	More:	Competent Assertiveness (.238)
	Less:	Overall Anxiety (-.301)
T-Wave Amplitude	Less:	Decisive (-.266)

**CONCLUSIONS** 1. There are significant relationships between physical fitness variables and psychological variables, as demonstrated by measurements on this sample of 80 subjects.

2. Dynamic strength, as measured by number of dips, correlated significantly with six psychological variables. More dynamic strength relates negatively to personality traits described as emotional, tense and withdrawn.

3. An individual who shows more power as measured by the Larson C-VJ-D test tends to be less anxious, less emotional, more poised and less unsure. Four of the five significant psychological factors reinforced one another on these relationships.

4. Heartometer measurements (systolic wave amplitude, diastolic wave amplitude, area under the wave, sitting pulse rate) all reflect direct relationships with 3 to 6 psychological variables.

5. Body Measurement Variables, such as Muscular Index, Biceps girth, and Shoulder width, relate significantly to many personality traits. This supports the theory that personality is related to physique.

Microfilm \$2.00; Xerox \$6.80. 143 pages.

#### EDUCATION, PSYCHOLOGY

##### THE EFFECT OF TEACHER ATTITUDE ON ELEMENTARY CHILDREN'S SCIENCE INFORMATION AND SCIENCE ATTITUDE

(L. C. Card No. Mic 59-249)

James Edward Bixler, Jr., Ph.D.  
Stanford University, 1958

This research investigates the effect of five variables on pupil learning: (1) teacher attitude toward science,



(2) teacher degree of authoritarianism, (3) teacher attitude toward desirable teacher-pupil relations, (4) children's intelligence, and (5) children's sex. The study examines the effect of these variables upon the children's pretest and posttest scores on science information and science attitude tests.

Hypotheses concerning direction of changes in children's learnings were generated from statements found in science education literature concerning the effect of teacher attitude and personality upon pupils. It was hypothesized that: (1) teachers who possess more favorable attitudes toward science, (2) teachers who are relatively non-authoritarian, and (3) teachers whose attitudes are consistent with desirable teacher-pupil relations would bring about greater positive change in pupil learning. The effect of children's intelligence and children's sex on learning was explored but no hypotheses stated.

Instruments used to obtain the data were: (1) Edwards and Kilpatrick's Attitude Toward Science Scale, (2) California F-scale, (3) Minnesota Teacher Attitude Inventory, (4) Brown's California Elementary School Science Information and Science Attitude Test, and (5) California Test of Mental Maturity. In September, 1957, sixty-two intermediate grade level teachers took scales indicated in numbers (1), (2), and (3). During the second week of the 1957-1958 school year, 1767 children participated in the pretest of science information and science attitude (4). Five months later, 1481 completed the posttest. The school district's psychological service furnished 1178 intelligence quotients (5) for the study. The children's initial and final scores were regrouped five ways, three based on teacher scale data and two on children's sex and intelligence.

The critical ratio (C.R.) reporting the effect of teacher attitude toward science on children's information approached significance when evaluated by a one-tailed test. The required C.R. = 1.64 and the obtained C.R. = 1.63. The children's science attitude test scores changed significantly, .01 level, indicating that the teacher attitude toward science was a contributing factor to attitude changes.

The teacher attitude toward science was more closely related to the means of evaluation, to the children's science information and to science attitude than were the other two teacher variables. Reasonably, those teachers possessing the most favorable attitude would be the ones most likely to put forth the consistent effort necessary to develop like attitudes in children. If desired changes in attitudes are to be developed, a conscious effort on the part of instructors must be made in order to produce the changes.

The C.R.'s for teacher degree of authoritarianism and attitude toward desirable teacher-pupil relations were not significant. Children's sex also did not contribute to differential changes significantly.

Both science information and science attitude were inversely related to children's intelligence. The differences were significant, .05 and .01 level, in favor of the lower of any two groups compared. The data shows that the attainment of scientific attitudes by children constitutes an obtainable educational objective for most. Whatever the reason underlying the inverse relationship between learning by bright and slower learners, the problem of inequitable achievement favoring the slower learner needs to be resolved.

Instruments used in this study were pencil-and-paper attitude scales. Classroom behavior associated with these

scales needs to be investigated. At present, researchers could reasonably hesitate to recommend these scales to teachers and administrators as instruments for applied research in typical classroom settings.

Careful testing of beliefs held as educational objectives and the examination of methods used to obtain them can go a long way toward shifting science education from the present status of using expedients to using considered actions based on the findings of research.

Microfilm \$2.00; Xerox \$6.60. 136 pages.

#### ASSUMED RACIAL SIMILARITY AS RELATED TO ATTITUDES TOWARD INTEGRATION

(L. C. Card No. Mic 58-2809)

Theodore Franklin Dunn, Ph.D.  
The American University, 1958

#### OBJECTIVES

The main purpose of the study was to test the hypothesis that the amount of similarity individuals assume to exist between the white and Negro races (Assumed Group Similarity) covaries with their attitudes toward integrated schools.

Supplementary objectives included (1) the construction and validation of experimental instruments; (2) a comparison of stereotyped versus non-stereotyped traits in measuring Assumed Group Similarity; (3) a determination of the relationship between authoritarian tendencies and the experimental variables; (4) an investigation of the methodological problems associated with the measurement of Assumed Group Similarity.

#### SAMPLE AND METHOD

The Group Characteristic Scale (designed to measure the amount of trait similarity an individual perceives between the white and Negro races); A Scale for Measuring Attitudes toward Integrated Schools; and the Opinion of Behavior Scale (a short form of the California F scale) were administered to 285 whites and 103 Negro persons in the Washington, D.C. area. Intercorrelations of these three variables under varying conditions supplied the basic data with which to test the main and supplementary hypotheses.

#### RESULTS AND CONCLUSIONS

The major findings and conclusions of the study may be summarized as follows:

1. Among white individuals varying in their attitudes toward integrated schools, there exists a covariation in their willingness to assume similarity with members of the Negro race. This conclusion stems from the correlation of -.56 between scores on the Group Characteristic Scale and attitudes of white subjects toward integrated schools. This relationship was not supported among Negro subjects.

2. Among white and Negro individuals varying in their authoritarian tendencies, there exists a covariation in their willingness to assume similarity with members of the opposite race. Authoritarian tendencies, as measured by the Opinion of Behavior Scale, correlated .33 and .27 with Assumed Group Similarity in the white and Negro samples, respectively.



3. High authoritarian tendencies are prone to be accompanied by unfavorable attitudes toward integrated schools and vice versa. The correlations between the Opinion of Behavior Scale and attitudes toward integrated schools were  $-.40$  and  $-.21$  in the white and Negro samples, respectively.

4. Two types of sub-scores for the Group Characteristic Scale were developed -- one based on stereotyped traits and the other based on non-stereotyped traits. The results of the intercorrelation of these two sub-scores ( $.86$  in the white sample;  $.82$  in the Negro sample) and the similarity of their correlations with A Scale for Measuring Attitudes toward Mixed (Integrated) Schools and the Opinion of Behavior Scale led to the conclusion that the amount of similarity an individual assumes to exist between races is similar for Assumed Group Similarity based on stereotyped and non-stereotyped traits.

5. The Group Characteristic Scale was scored by two different methods. The first, distance-scoring, had the effect of yielding a geometric distance score between the description of the two groups in an "n" dimensional space; "n" being the number of items in the scale. The second, difference-scoring, was computed by simply taking the average difference between an individual's descriptions of the two groups for each item. It was concluded from the correlation of  $.85$  between scores resulting from the two scoring methods that in the white sample distance-scoring of the Group Characteristic Scale yield substantially similar results to simple difference-scoring of the scale. In the Negro sample, the two methods of scoring yield dissimilar results.

6. Assumed Group Similarity scores (reference group scores) are better able to predict attitudes toward integrated schools, than are scores which simply reflect white persons' opinions of the traits possessed by Negroes without reference to their opinions of their own group (non-reference group scores). Non-reference group scoring of the Group Characteristic Scale correlated  $-.49$  with attitudes toward integrated schools. Comparable reference group scoring of the Group Characteristic Scale correlated  $-.60$  with attitudes toward integrated schools. These two correlations were significantly different from one another at better than the  $.05$  level.

Microfilm \$2.25; Xerox \$7.80. 169 pages.

### THE INFLUENCE OF TEACHERS' INTRODUCTORY REMARKS ON STUDENT PERCEPTION OF WRITTEN MATERIALS

(L. C. Card No. Mic 59-264)

Louis Fischer, Ph.D.  
Stanford University, 1958

#### Purpose

This study was designed to investigate the effects of teachers' oral introductory remarks on student perception of written materials. In light of previous findings in the area of social perception, the following hypotheses were posed:

The major hypothesis predicted that student perceptions would be significantly influenced by the teachers' oral introductory remarks.

The second and third hypotheses respectively explored the relevance of the variables of intelligence level and sex to the development of a perceptive "set."

#### Procedure

##### Instruments Used

In order to examine the influence of teachers' introductory remarks on student perception, a brief article was written to be used as stimulus material. It contained information of equal amounts and difficulty on the topics of Smog and Pittsburgh, Pennsylvania. The article was constructed to have continuity in content and be easily readable in spite of its two distinct content areas. A 34-item multiple choice test was built to sample the content of the stimulus article. Test items of equal number and difficulty sampled the Smog and Pittsburgh contents. The test-retest method was used to determine test reliability.

##### Administration of Instruments

The stimulus article was read by three comparable groups of students. They were comparable along the variables of age, intelligence level, and reading ability. The groups read the article under the following conditions:

1. The regular classroom teacher of each group administered the article and the test pursuant to specified directions.
2. The first group was introduced to the article after general directions, which focused on neither topic contained therein.
3. The second group was introduced to the article after introductory remarks that focused only upon the Pittsburgh content.
4. The third group was introduced to the article after introductory remarks that focused only upon the Smog content.
5. All of the groups took the same multiple choice test based upon the article.
6. A fourth comparable group also took the test without previously reading the stimulus article.

##### Sample

The subjects of this study were all high school seniors in a middle sized California high school. The suburban community wherein the study was conducted has a population of about 50,000. The population, although actually representing the several socio-economic classes, is heavily middle and upper middle class in composition and value orientation. About eighty percent of the students continue formal education beyond the high school.

The senior problems class, a required course, was selected for the administration of the instruments. All students took this course, and no efforts were made by school administrators to form any type of homogeneous class groups. Thus these classes were likely to have comparable distributions of intelligence and reading ability. This judgment, upon analysis, turned out to be correct.

#### Conclusions and Implications

The simple analysis of variance technique was used to determine the overall influence of the introductory remarks. This was followed by tests of Critical Ratio. These techniques provided answers to the major hypothesis. To answer the second and third hypotheses the subjects were



divided into intelligence categories according to the California Test of Mental Maturity, and later into sex categories. The group mean scores were then compared and the results scrutinized in terms of the respective hypotheses, using "t" tests to analyze differences for significance.

Statistical differences, significant at or below the .01 level were brought about by the introductory remarks of the teachers. The major hypothesis was confirmed by the results.

The second and third hypotheses were not supported by the experimental evidence.

The significant implication for educators is that specific introductions are highly superior to general ones. Students will do better on all content areas when attention is focused on any one of them.

More research is needed to test possible interactive influence of the variables of sex and intelligence on perception. Microfilm \$2.00; Xerox \$5.20. 102 pages.

#### PREDICTIVE FACTORS ASSOCIATED WITH ACHIEVEMENT AND SUCCESS IN COLLEGE ALGEBRA

(L. C. Card No. Mic 58-5943)

Walter Thomas Graybeal, Ph.D.  
The University of North Carolina, 1958

Supervisor: A. M. Jordan

**Purpose:** This study was carried out in order to discover which of several selected factors, available at or near the beginning of a school term, are the most reliable predictors of the criteria of achievement (as indicated by the sum of raw scores on two objective tests in algebra) and success (as indicated by instructors' marks given at the end of course work) in college algebra.

**Procedures:** Information sources selected included interest inventories, intelligence tests, information forms (questionnaire and study-time record), measures of computational skills, and secondary school statistics. From these sources seventy-one separate factors were obtained for use in the investigation. These data were gathered on each of one hundred students taking a course in college algebra, half at a liberal-arts college and half at a teacher-training institution, located in adjoining southern states.

Pearson product-moment, or point-biserial, correlation coefficients, as appropriate, were calculated for each factor with each criterion. Those factors which were found to be predictive at the .05 or the .01 level of significance were studied further by means of partial and multiple correlations, and by use of the Doolittle Method. Regression equations were calculated for significant factors and factor-sets involving one, two, and four independent variables.

**Educational Applications:** In order to make the results of the study more available for use in departmental guidance work, suggestions were made relative to ways and means for the practical application of these results to educational problems. These included, in addition to the regression equations, cutoff points and a multiple-cutoff profile, graphs in one and two independent variables, tables (with an illustration involving four independent variables), and simplified regression equations.

**Results and Conclusions:** (1) Personal interests play non-existent roles in predicting achievement, but rather influential supporting roles in predicting success. (2) Vocational interests seem to play minor roles in predicting achievement and non-existent roles in predicting success. (3) The best single predictor of either achievement or success in college algebra is the measure of incidental or residual knowledge of fundamental algebraic processes as indicated by scores on a diagnostic or pre-test in the subject. (4) With incidental or residual knowledge of algebra held constant, reasoning and intelligence test scores carry the greatest predictive weight for achievement while high school grades in mathematics carry the greatest predictive weight for success. (5) While certain biographical factors play only minor roles as single-factor predictors, when considered in combination with other predictors they may help form highly predictive sets. (6) A carefully kept study-time record seems to play an important complementary role in combination with other factors for predicting success. (7) Skills in arithmetical computation carry approximately the same overall weight in predicting either criterion, although individual categories (whole numbers, fractions, decimals, per cents) vary rather widely from one criterion to the other. Per cents is the best category for predicting achievement while fractions is the best for predicting success. (8) Rating by principal and rank in graduating class were useful primarily as complementary factors for predicting achievement and success respectively. Microfilm \$2.80; Xerox \$9.60. 214 pages.

#### ATTITUDES TOWARD SPECIAL EDUCATIONAL PROGRAMS FOR GIFTED CHILDREN

(L. C. Card No. Mic 59-240)

Norman Knight Hamilton, Ed.D.  
Stanford University, 1958

This study was designed to ascertain some general attitudes and opinions of parents, teachers, and children about the characteristics of gifted children and the instructional programs schools provide for them, and further to ascertain the degree of relationship of specific variables to expressed attitudes and opinions. The data for the study were obtained by the administration of especially designed instruments to 989 parents, 524 teachers, and 632 children of junior and senior high school age, all of Portland Oregon.

Parents, children, and teachers were found to vary in their attitudes toward gifted children from those who visualized them as possessing only positive characteristics to those who visualized them as possessing many negative characteristics.

Respondents were almost unanimous in their approval of the idea of having the schools provide special programs for gifted children. Favorable responses were: parents --90%, teachers--95%, and children--84%. Most respondents were also favorable, to some degree, in their opinions about the local program for the gifted.

Opinions of parents were related to the following variables: (1) socio-economic status, (2) aspirations for offspring, (3) perception of degree of ability of offspring, (4) identification of offspring with the local program,



(5) degree of familiarity with the local program, (6) desire to have a child participate in the program, and (7) attitudes toward gifted children. The sex of the offspring had no relationship to parent responses.

Opinions of teachers were related to (1) amount of teaching experience, (2) involvement in the local program for the gifted, (3) attitudes toward gifted children, and (4) attitude toward the role of children in the classroom as measured by the Minnesota Teacher Attitude Inventory. No significant relationship between the opinions of teachers was evident according to these variables: (1) amount of college training, (2) sex, (3) grade level, and (4) subjects taught.

Opinions of children were related to (1) grade level, (2) sex, (3) aspirations, (4) self-concepts of ability, (5) identity with the local program, (6) desire to participate in the local program, and (7) attitude toward gifted children.

Majorities of each group approved of a broad program of special offerings for the gifted. Parents, teachers, and pupils were alike in favoring such names as "special interest classes" or "advanced classes" and rejecting such names as "classes for superior," "exceptionally endowed," "gifted," "talented," or any term which tended to identify the child as part of an "elite" group.

The generalizations drawn from these data about the attitudes of parents, teachers, and children are:

1. Each child is valued for his uniqueness and should have an educational program to help him develop to his potential.
2. Schools should not label certain children as superior and thus schools will avoid creation of an anti-social elite.
3. Diligent effort should be recognized by opportunities to advance in school work.
4. Adverse opinions toward school programs for the gifted are often associated with a negative attitude toward gifted children or with a negative concept of the role of children in the classroom.
5. Pupils' high self-concepts or parents' perception of high ability in offspring leads to a high degree of approval of special programs for the gifted.
6. High aspirations tend to be related to the degree of approval of a program for the gifted.
7. Familiarity, proximity, and involvement with a successful program for the gifted lead to greater approval of the program.
8. Socio-economic status is related to the opinions of parents to the extent that such a dimension reflects parents' concepts of ability of their offspring, aspirations for offspring, and familiarity with a successful program for the gifted.

The author concludes that sound educational programs for the gifted need not be in conflict with public attitudes and opinions. Microfilm \$3.85; Xerox \$13.00. 299 pages.

## A BIOLINGUISTIC INTRODUCTION TO PHYSIOLOGICAL DETERMINANTS OF DYSSYNERGIA

(L. C. Card No. Mic 59-924)

Frances Vlerebome Henry, Ph.D.  
University of Michigan, 1957

The purpose of this study is to evaluate the relationship of oral specificity to speech by means of a training period in oral gymnastics. A study of possible physiological differences between stutterers and non-stutterers has been undertaken. It is concluded that the syndrome of muscle spasms in stuttering can be modified by training in oral gymnastics. A study of trainability of the tongue is included.

Data was used from twenty subjects: six who had normal speech and fourteen who stuttered. A training period of eight weeks was set up with the group meeting twice a week. At the beginning of the period movies were taken of tongue movements and positions. Also tape recordings of "baa, baa, black sheep" and "K-K-K-Katy." These were compared with movies and tape recordings repeated at the end of the training period.

X-rays of the head and neck in profile were made to show fragmentation of the speech processes in terms of lingual position relative to hyoid bone position, and opening and closure of the aditus laryngus.

Physiological data in terms of blood studies, cardiac rhythms and thyroid function were gathered during the period. Also palatograms and kymograms were made.

The results showed that the average rate of improvement on oral gymnastics as measured by comparison between initial and final movies was 85%. Tape recordings showed that eighteen of the twenty subjects improved in voice quality, pitch, articulation, etc. Stutterers with a larger possible gain to make averaged 14.85 points gain out of a possible 19.56 points. Non-stutterers with less need and room for improvement showed an average gain of 4.8 points per subject out of a possible 9.5 points.

X-rays demonstrated that spasms of the middle constrictor of the pharynx tilts the hyoid bone posteriorly and that this malpositions the tongue to interfere with articulation. This tilting also throws the whole laryngeal mechanism into the swallowing position, thus closing the aditus laryngis. Before training stutterers showed hyoid tilting five times as often as the non-stutterer and eight out of fourteen had closed laryngeal valves as against one non-stutterer. Tongue position was normal in every subject in the x-ray made after training.

Cardiac rhythms of stutterers are more irregular than those of non-stutterers. Stutterers had lower systole, diastole and mean pressure measures. Heart rate was either too slow or too fast in all stutterers and respiration was too fast in every stutterer.

In the total pattern of blood studies stutterers showed a 70% deviation from normal while non-stutterers showed only a 35% deviation from normal measures. Deviations in hemoglobin, hematocrit, white cell count and neutrophils, basophils, eosinophils were present in all stutterers. Non-stutterers did not follow this pattern. There were pattern differences between subjects who had stuttered since childhood and those whose stuttering onset had been recent. Only one stutterer from childhood had normal thyroid activity. All of the recent stutterers had normal thyroid activity as did the non-stutterers.



Stutterers since childhood had high serum calcium, recent stutterers had low serum calcium and non-stutterers were within normal limits.

Palatograms showed by inspection characteristic contact differences. The stutterer showed highly irregular patterns and a greater degree of contact than the non-stutterers.

Kymograms were not measurable in details of difference except that the non-stutterers exhaled evenly on speech with a predominance of diaphragmatic-abdominal breath control, while the stutterer tended toward thoracic breathing and showed spasms in the exhaling pattern.

The study demonstrated that (1) training in oral gymnastics will increase lingual specificity and (2) that there are evident differences between the physiological profiles of stutterers and non-stutterers that are suggestive of relationships which merit further examination.

Microfilm \$2.30; Xerox \$8.00. 175 pages.

#### THE EFFECT OF PROFESSIONAL INFORMAL SOCIAL GROUPS UPON TEACHER MEMBERS' ATTITUDES, VALUES AND NORMS

(L. C. Card No. Mic 59-241)

Chester Ralph Ingils, Ed.D.  
Stanford University, 1958

This study is designed to investigate the relationship between the public high school teacher's membership in informal professional faculty groups and the teachers' attitudes, values and norms. The attitudes, values and norms with which the study is concerned are limited to the attitudes directly related to the teaching profession.

Data were gathered through a questionnaire completed in the presence of the author from the teachers of a large high school in central California.

Each teacher named the members of the faculty group to which he felt he belonged and a group to which he did not belong. The experimental instrument also measured the degree to which the individual was attracted to the membership group and to the non-membership group. The main portion of the questionnaire consisted of a battery of sixteen items designed to measure the high school teacher's:

- (1) Perception of his professional attitudes, values and norms.
- (2) Perception of his membership group attitudes, values and norms.
- (3) Perception of the other groups attitudes, values and norms.

Through sociometric "pick" informal social groups and their memberships were determined as well as were the "real" group norms of such groups.

The following significant facts emerged from the study:

- (1) The degree of cohesiveness or reciprocity of group member choice is a factor in the extent to which there is conformity of the individual's values and norms to the "real" group norms. This might be thought of from two frames of reference:

- (a) Pressures exerted by the "close" membership group to bring about conformity to the individual's values and norms to the "real" group norms. When this is accomplished to the desired degree of the group on its

member, the behavior of expectancy of the members reflect the totality of the whole.

(b) The "close" membership group is a highly selective agency accepting into its membership only those persons who manifest the behavioral expectancy of the group norm. Syntality of the group is then accomplished and perpetuated by accretion rather than interaction and group pressures.

(2) The degree to which a person is attracted to membership in an informal professional social group is not predictive of the degree to which that individual conforms to the "real" group norms or affects individual's perception of the group norm.

(3) The enactment of the group role expectancies, through the behavioral patterns of the individual group members, is not indicative of the member's perception of his own norms or his perception of the group norms.

(4) The individual has some inherent predisposition to perceive the standards of groups in terms of his own personality. This phenomenon of individuality of perception is consistent within the individual and the direction and degree of the judgment of social norm from instance to instance and is not conditioned by social pressures for conformity. Microfilm \$2.00; Xerox \$4.00. 74 pages.

#### A COMPARATIVE INVESTIGATION OF THE ACADEMIC ACHIEVEMENT AND PERSONALITY DEVELOPMENT OF GIFTED SIXTH GRADE PUPILS IN A SPECIAL CLASS AND IN REGULAR CLASSROOMS IN THE PUBLIC SCHOOLS OF GREENSBORO, NORTH CAROLINA

(L. C. Card No. Mic 59-52)

Jack Shiefler Luttrell, Ph.D.  
The University of North Carolina, 1958

Supervisor: W. D. Perry

The purpose of this investigation was to compare (1) the academic achievement and (2) the personality development of twenty-seven gifted sixth grade pupils who were in a special class with the academic achievement and personality development of a comparable group who were in eight regular classrooms. The sole criterion of selection for these pupils was a Stanford-Binet I.Q. of 130 or above.

The procedure was to measure achievement and personality in the fall and again in the spring and compare the results of the two measurements. The instruments used were the Stanford Achievement Test, Intermediate Partial Battery, Forms K and L, the Mental Health Analysis by Thorpe and Clark, and the Social Traits Rating Scale by Jordan and Thurstone. The achievement was measured in October and May and the personality in November and May.

In the area of academic achievement the mean gains in tenths of a year were compared for both groups in reading, spelling, language, arithmetic, and total achievement. The difference of the means was calculated and the t test of significance applied to these differences. Significantly greater gains at the .01 level of confidence were made by the experimental group in spelling, arithmetic and total achievement. The gain in language made by the experimental group was significantly greater at the .05 level of



confidence while the slight difference in reading was only significant at the .4 level of confidence. These results indicated significantly greater gains were made by the experimental group in all areas of academic achievement measured except reading.

The results of the Mental Health Analysis indicated almost equal improvement by both groups. On the initial measurement the control group mean total score was at the 85th percentile while the experimental group was at the 78th percentile. The posttest revealed a gain of six percentiles by both groups which suggests that segregation did not impair the mental health of gifted sixth graders any more than placement in a regular class did.

The results of the Social Traits Rating Scale, which required a rating on ten items by the teachers, revealed high similarity between the two groups in the fall. The spring rating indicated greater incidence of such undesirable personality traits as "boastful," "bossy," "noisy," "quarrelsome," and "sulky" among the control group. This suggests that segregation of the gifted might reduce the incidence of the undesirable traits. The sociometric measure of this scale completed by the pupils revealed a high degree of acceptance of the gifted child in the regular classroom. The presence of a few isolates, however, points out the fact that intellectual superiority and social acceptance are not necessarily combined in the gifted individual.

The sample was small and the period of measurement relatively short but under the conditions of this experiment the results favor the experimental group. In the area of academic achievement significantly greater gains were noted in the experimental group even though the instrument of measurement had a low ceiling for gifted sixth graders. The personality development of the experimental group, as measured, apparently was not different from that of the control group. Indeed, the incidence of certain undesirable personality traits seems to have been reduced through such grouping. Microfilm \$2.00; Xerox \$6.60. 139 pages.

#### PATTERNS OF CIRCUMSTANCES RELATED TO PROBLEMS EXPRESSED BY SEVENTH AND EIGHTH GRADE PUPILS

(L. C. Card No. Mic 59-832)

Dayton L. Musselman, Ed.D.  
University of Colorado, 1958

Supervisor: Associate Professor Clarence W. Failor

The purpose of this study was to secure descriptive information about the problems expressed by seventh and eighth grade pupils in relation to their behavior, achievement, academic abilities, parent relationships, transiency, and church attendance. The interrelationships between and among these factors were sought as curriculum and guidance program guides and as a stimulation to increased teacher interest in and understanding of pupils and their environments.

All of the pupils of the seventh and eighth grades in the nine public schools for these grades of a Midwestern city of approximately 135,000 population were asked to express their problems on the SRA Youth Inventory, Form A. The total number of problems expressed by each of 2303 pupils

in each of five selected areas of the checklist: My School, About Myself, Getting along with Others, My Home and Family, and Health, was recorded.

As measures of academic ability, the Otis Quick-Scoring Test of Mental Ability, Beta Form, and the Iowa Silent Reading Test, Elementary Form, were administered. Measures of achievement were secured from the average school marks for the semester and from the composite scores of the Iowa Test of Educational Development.

Two criteria for selecting pupils on the basis of behavior were used. The pupils who had been summoned officially before the juvenile authorities during the year were selected as a group whose behavior was not socially acceptable. Two other groups, those pupils whose school behavior indicated that they were getting along well with others and those who were not, were selected from those names most frequently suggested by teachers.

Three standard statistical procedures were used to test the significance of the relationships between and among the data. The Fisher "t" for significance of difference between the means of independent groups was computed for problems expressed by paired groups of pupils for each area of the Inventory, as well as total problems. The chi-square was used to test the significance of the differences in the categorized variables of mental ability, reading grade levels, family living patterns, number of schools attended, and church attendance habits. The final computation was that of rank correlation of the nine schools of the study in each of the factors of the study.

The findings indicate that the tendency to express more problems on the SRA Youth Inventory is positively interrelated with the following circumstances: lower achievement as measured by school marks and by standardized test, lower mental ability as measured by a group test, lower reading ability as measured by group test, less desirable behavior as measured by teacher judgment and by juvenile misdemeanors of record, more school transiency, greater per cent of Negroes, more broken homes, and less regular church attendance.

The differences among schools were very significant. The rank of each school in total problems expressed was consistent generally with its rank in the personal and environmental circumstances of its pupils. The highest intercorrelations were between the rank of schools in total problems expressed, the rank on a standardized achievement test, and the rank in per cent of pupils living with both parents.

The findings, in general, indicate that a problem checklist tends to obtain responses which are quantitatively different between and among groups of seventh and eighth grade pupils of different personal and environmental circumstances. The tendency to perceive more situations about self and environment as problems seems to be related to constellations of circumstances rather than to any one circumstance. The interrelationships seem to support a concept of problem proneness which represents a general disposition or sentiment toward self and environment held by certain groups of pupils with common biographical elements. Microfilm \$2.65; Xerox \$9.20. 201 pages.



FACTORS ASSOCIATED WITH HIGH AND LOW  
CORRELATIONS BETWEEN INDIVIDUALS'  
SCORES ON TWO INTEREST INVENTORIES

(L. C. Card No. Mic 59-690)

Abdel-Kader Namani, Ph.D.  
Cornell University, 1958

Chairman: A. Gordon Nelson

Purpose

The purpose of the study was to examine certain data pertaining to a group of males in an effort to determine the relationships between certain factors and a high or a low correlation between the scores of these individuals on the Kuder Preference Record--Vocational, and the Strong Vocational Interest Blank for Men. For cross-validation, data concerning a second group of males were then analyzed.

The ultimate objective of the study was to discover criteria by which one could identify the members of a group, to whom the Kuder inventory was administered, who would be expected to indicate high correlations between their scores on the Kuder and the Strong, if the second inventory were also administered to them.

Sources of Data

Of the clients who came to the Cornell Guidance Center between October, 1950 and May, 1953, inclusive, there were 108 males to whom both the Kuder and the Strong interest inventories were administered, and these 108 males comprised the Test Group. In addition, of the clients who came to the Guidance Center between December, 1953 and June, 1957, inclusive, there were 50 males to whom both the Kuder and the Strong were administered, and these 50 males comprised the Cross-Validation Group.

Analysis of the Data

In order to examine relationships between twenty-six specific factors (such as age, scholastic aptitude, and realism of occupational choice) and a high or a low correlation between the scores of individual on the Kuder and the Strong inventories, a systematic investigation of them was made, employing statistical techniques appropriate to the various kinds of data provided. The following four statistical techniques were employed: (1) a critical ratio computed from a comparison of means, (2) comparison of percentages, (3) chi-square ( $X^2$ ), and (4) the method of the median test. Comparisons were made between the twenty-five per cent of the Test Group (27 cases) which displayed a rank-order correlation of .72 or greater and were called the high group, and the twenty-five per cent (27 cases) which displayed a rank-order correlation of .31 or less and were called the low group.

Findings and Conclusions

Two of the twenty-six factors studied indicated relationships between the high and low groups which were statistically significant. "Realism" of occupations considered by the client (in the light of his Kuder scores), and "Agreement" between his best-liked subjects in high school and his Kuder scores in areas of interest related to these subjects, indicated statistical significance at the one and five per cent levels, respectively.

Calling "realism" of occupations considered, the first

indicator, and "agreement" between best-liked subjects in high school and Kuder scores, the second indicator, the major findings of the cross-validation part of the study are summarized as follows:

1. When subjects exhibit either indicator, (but do not exhibit both), it can not be predicted whether they would show high or "not high" (below .72) correlations between their scores on the Kuder and the Strong inventories. The chances are even that they would indicate either.
2. When subjects fail to exhibit one of the two indicators, (but not both), they would be expected to have correlations which are "not high." The probability is nine to one that they would (for the sample investigated).
3. Subjects exhibiting the first and second indicators, simultaneously, would be expected to have a tendency to have "high" correlations. The chances are two to one that they would have such correlations.
4. Subjects who do not exhibit either indicator would be expected to have correlations which are "not high." The probability is nine to one that they would.

A comparison of probabilities reported above shows that the chances of identifying the individuals who would not indicate high correlations are far greater than the chances of identifying those who would.

Microfilm \$2.05; Xerox \$7.40. 156 pages.

ORAL READING USED AS AN INDICATOR OF  
REACTIONS TO FRUSTRATION: A STUDY OF OVERT  
BEHAVIOR IN THE READING SITUATION TO  
REVEAL BEHAVIORAL REACTIONS IN CHILDREN OF  
DEPENDENCE, AGGRESSION, AND WITHDRAWAL

(L. C. Card No. Mic 58-2130)

Gladys W. Natchez, Ph.D.  
New York University, 1958

Chairman: Professor Nila B. Smith

Statement of the Problem

The purpose of this investigation is to determine the relationship between the frustration behavior of a retarded reader in a reading situation as compared with his frustration behavior in other situations.

Significance of the Problem

Reading disability and emotional disturbance have been associated for many years. However, no conclusive evidence has been derived to indicate in what way emotional disturbance is related to a child's approach to the reading task. In order to shed light on this relationship, it is necessary to examine the reactions of the retarded reader during reading as well as in circumstances other than reading.

Previous Research

It was observed from research studies that the reactions of retarded readers to reading were quite similar to reactions of individuals who were regarded as frustrated. As



a result, it was deduced that reading is a frustrating situation for such a child. Three reactions, dependence, aggression, and withdrawal, reported as typical of the retarded reader as well as frustrated individuals, were selected for study. The experiment explores the relationship between these reactions during reading and during situations other than reading.

#### Procedure

Two groups of thirty retarded and non-retarded readers each, were matched on the basis of age, sex, intelligence, and grade. Their behavioral reactions while reading orally during a classroom exercise were compared. The investigator and another reading specialist who acted as an observer, observed manifestations of dependence, aggression, and withdrawal reactions. These reactions were recorded on a check sheet especially developed for this purpose. The data were analyzed by comparing the means of total reaction scores of each group.

In addition, fifty-nine retarded readers' behavior was observed during reading and non-reading situations. Data for the reading situations were secured from reactions manifested during a classroom reading lesson and a controlled equivalent individual session. Data for the non-reading situations were derived from a series of four circumstances including teachers' ratings, peer' rating, case histories, and reactions to an experimentally devised frustration-type task.

#### Results

1. The retarded reading group had significantly higher mean total reaction scores than the group of non-retarded readers.

2. A high degree of relationship appeared between reaction scores in non-reading situations and reaction scores secured in reading situations.

a. High positive correlations were obtained between similar reaction scores derived from the non-reading and reading situations. For instance, withdrawal in non-reading correlated positively with withdrawal in reading.

b. Insignificant, negative, or low positive correlations were obtained between dissimilar variables. Dependence in non-reading, for instance, correlated negatively with withdrawal in reading.

c. The frequency by which subjects could be re-classified into the expected reaction categories, dependence, aggression, or withdrawal, was significantly greater than chance alone would allow. That is, subjects designated originally as belonging to either a dependence, aggression, or withdrawal group according to reactions secured in non-reading situations, were generally re-categorized into the same groups on the basis of responses observed during oral reading sessions.

#### Conclusions

The foregoing analyses permit the following conclusions to be drawn:

1. Children who have reading difficulty experience considerable distress during the reading situation. This distress may evoke frustration reactions, such as excessive dependence, aggression, and withdrawal. When engaged in oral reading, retarded readers generally manifest

a significantly greater proportion of these three reactions than non-retarded readers.

2. There is a significant relationship between reactions manifested by retarded readers in reading situations and in frustration situations other than reading. That is, a retarded reader whose reaction to frustration can be described characteristically as either dependence, aggression, or withdrawal will tend to display the same type of behavior during a reading exercise.

Microfilm \$2.10; Xerox \$7.40. 157 pages.

#### A METHOD FOR THE QUANTIFICATION OF INTERACTION IN PSYCHOTHERAPEUTIC GROUPS

(L. C. Card No. Mic 59-550)

Frank Channing Noble, Jr., Ed.D.  
University of Illinois, 1958

**Purpose:** The purpose of this study was the development of a method for the observation and quantification of the interaction that occurs between the participants in psychotherapeutic groups. A review of the methods previously employed in the study of the psychotherapeutic process revealed the need for a method that would enable observers to accurately record the complex verbal and non-verbal interaction as it occurs in these groups. Some method for the detailed analysis of what actually occurs during group therapy is absolutely essential if the therapeutic process is to be understood and improved.

**Procedure:** Using Bales' system of interaction process analysis as a base and revising it to include the more complex and specifically therapeutically oriented categories of Gorlow, Hoch and Teleschow, a new system of categories and method of observation was devised. The system included twelve Client and twelve Therapist categories:

**Client categories:** Accepts Self, Accepts Others, Agrees with Others, Gives Suggestion, Gives Opinion, Gives Information, Asks for Information, Asks for Opinion, Asks for Suggestion, Disagrees with Others, Rejects Others, Rejects Self.

**Therapist Categories:** Simple Acceptance, Agrees with Client, Reflects and Clarifies Feeling, Asks Client for Information, Asks Client for Opinion, Asks Client to Discuss Plans, Gives Information to Client, Gives Opinion or Interpretation, Gives Client Suggestion, Takes Responsibility for Client, Disagrees with Client, Rejects Client.

Provision was made for recording of the verbal and non-verbal behavior of the principal therapist and the group members acting either as clients or member-therapists. The method of observation required a four-member observation team: the Interaction Recorder, the Client Observer, the Therapist Observer and the Non-Verbal Observer.

Following the development of the method, two observation teams were trained and employed in a trial analysis of the therapeutic process. Each team observed a separate therapy group for a total of sixteen sessions. Closed-circuit television made possible close observation of the groups without the distracting influence of having the observers in the therapy room. The groups observed consisted of fourteen gifted, underachieving ninth grade



students of both sexes selected at random from a larger population. Pre- and post-therapy and follow-up testing was conducted using a variety of achievement and personality tests. Both groups were seen by the same therapist.

**Conclusions:** Statistical analysis of the data gathered during the trial analysis supported the following conclusions:

1. Adequate between-observer reliability can be obtained using this method of therapeutic interaction analysis.
2. As indicated by the ability to predict the outcome of hypotheses concerning the nature of the therapeutic interaction, the method of observation produces data that is valid and useful in the analysis of the therapeutic process.
3. The analysis of pre-therapy picture stories is not useful in the prediction of either the quantity or quality of the member's behavior during therapy.

Microfilm \$2.00; Xerox \$6.60. 138 pages.

#### A STUDY OF 300 VOCATIONAL COUNSELING CASES OF VETERANS AND IMPLICATIONS FOR A VOCATIONAL COUNSELING PROGRAM FOR SECONDARY, VOCATIONAL AND OTHER SCHOOLS

(L. C. Card No. Mic 59-416)

John Pruski, Ph.D.

The Ohio State University, 1958

The purposes of this study were twofold. One was to analyze and evaluate the vocational counseling case summaries of three hundred disabled Korean veterans counseled by the VA under the provisions of Public Law 894. The second purpose was dependent upon the first. It involved projecting and proposing a similar counseling and testing procedure for public secondary and other school programs.

Data secured from each VA form VB7-1902h included counselee personal data, distribution of vocational counseling data, and frequency distribution of test measures used. The findings of the study follow:

1. The 22-25 year age group was the most prevalent, a finding that compared favorably with an earlier nationwide study.
2. Counselee average educational background was 10.5 grades. Eighty per cent had completed the eighth grade.
3. Mathematics or science was listed as a favorite course in 40 per cent of the cases.
4. Eighty-one per cent of the veterans had had work experiences of which manual level comprised 68 per cent. Ten per cent were students prior to service.
5. Orthopedic disabilities were represented in 40.6 per cent of the group and "nervous or mental" conditions in only 10.6 per cent.
6. Two or more D.O.T. three-digit occupational classifications were explored with 89 per cent of the veterans.
7. D.O.T. major occupational groups O-X and 4-X were explored with the greatest frequency.
8. Objectives involving mechanical work were selected by 41.3 per cent of the group.

9. A wide range of employment objectives was indicative of not too much limitation imposed by the veterans' service-connected disabilities.

10. Sixty-one per cent of the veterans chose institutional training. College and technical or trade schools were equally represented with 23 per cent each. Thirty-nine per cent preferred on-job training and only 1.7 per cent selected on-farm training.

11. Interest was measured 319 times. Each veteran's interest was checked at least once. Kuder Preference Record showed 92.3 per cent usage.

12. Thirty-five per cent were given personality measures. California Personality Test was used with the greatest frequency.

13. Army General Classification Test was used in 54.3 per cent of the cases. A non-language test was used only once.

14. One-third of the counselees were given one or more scholastic aptitude tests. The O.S.P.E. was used in 21.3 per cent of the cases.

15. Test of Mechanical Comprehension (Bennett) was used in 71.3 per cent of the sampling. Spatial perception was measured in 75 per cent of the cases.

16. Minnesota Clerical Test reflected 43.6 per cent usage.

17. Special aptitude tests were utilized sparingly. These apparently were used for confirmation purposes.

18. Study habit inventories were seldom used, even though 61 per cent of the veterans selected goals involving institutional training.

VA counseling has stimulated counseling on all school levels. Fifty per cent of the colleges cooperating with campus VA guidance centers had never previously provided counseling.

Counseling forms developed by VA seem to be adaptive for use in secondary and other schools. Tests used in VA counseling appear suitable for use in such programs.

Secondary programs of industrial arts and vocational education could be coordinated with vocational counseling to provide students with occupational information and work exploration necessary for wise vocational choices.

Similar vocational counseling services in technical and junior colleges may be an effective means of helping the 49 per cent of young people who are capable of attaining 14 years of education to choose appropriate vocational goals.

Microfilm \$2.55; Xerox \$9.00. 196 pages.

#### THE RELATIONSHIP BETWEEN VERBAL-QUANTITATIVE ABILITY AND CERTAIN PERSONALITY AND METABOLIC CHARACTERISTICS

(L. C. Card No. Mic 58-5085)

Ella Moye Sanders, Ph.D.

The University of Texas, 1958

Supervisor: Professor Oliver H. Brown

The purpose of this interdisciplinary investigation was to explore personality and biochemical attributes of subjects with large discrepancies in their verbal and quantitative abilities as compared to subjects with equal ability



in both areas. Clinical observation and limited previous research have yielded evidence that the person with high verbal ability and low quantitative ability is considerably different in personality, in general approach to life, work, and other people, and in certain aspects of his body chemistry from the person with high quantitative and low verbal ability or the person with equal ability in both areas. The present study hypothesized significant differences among three groups different from one another in verbal-quantitative ability in various personality characteristics and biochemical characteristics or metabolic patterns.

Scores received by male freshmen on the 1957 University of Texas Admission Test were used to select subjects in three groups matched for the higher of their ability scores. Group Vq was composed of subjects with high verbal and low quantitative scores, group vQ of subjects with low verbal and high quantitative scores, and group VQ of individuals with high verbal and high quantitative scores. High scores ranged from the 70th to the 99th percentile; low scores from the 40th to the 8th percentile.

Three personality instruments were administered to all subjects: The Edwards Personal Preference Schedule, the Holtzman Ink Blot Test, and the McGuire Q-check. Four overnight urine samples were obtained from each subject during the testing period. The samples were analyzed for 34 chemical constituents by the Clayton Foundation Biochemical Institute, the University of Texas.

Analyses of variance were computed for each of the 34 chemical constituents, 15 EPPS scales, and 7 HIT categories. A variance technique, developed by Carson McGuire, was employed to analyze the Q-check data. The statistical results permit the following conclusions: (1) certain aspects of the metabolic patterns of the three groups as measured in the present investigation differ significantly from one another; (2) certain personality characteristics of the three groups as measured by the EPPS and Q-check differ significantly from one another; (3) the seven HIT categories did not differentiate among the three groups.

The Vq group excreted a lesser amount of 27 of the 34 urinary constituents than the other two groups. Their performance on the Q-check indicated a significantly greater choice of items with an implicit intensional orientation to describe themselves than the other two groups and their manifest need for autonomy as measured by the EPPS were significantly greater than that of the vQ group.

The vQ group excreted a larger amount of 18 of the 34 urinary constituents than the other two groups. Their performance on the Q-check indicated a significantly greater choice of items with an implicit dependent or authority orientation and their manifest need for endurance as measured by the EPPS were significantly greater than that of the Vq group.

The VQ group excreted a larger amount of 15 of the 34 urinary constituents than the other two groups. Their performance on the Q-check indicated a significantly greater choice of items with an implicit extensional orientation and their manifest need for dominance as measured by the EPPS were significantly greater than that of the vQ group. Their manifest need for endurance was also significantly greater than that of the Vq group.

At the present stage of knowledge, it would be inappropriate to theorize about the mechanisms by means of which body chemistry, personality and verbal-quantitative ability are related. One can not say which is cause and which effect, or whether the three are common effects of a cause

which may be inherent in the constitution of the individual and which has not yet been determined. Theory must wait upon more detailed knowledge of the facts.

Microfilm \$2.00; Xerox \$6.20. 127 pages.

#### CONCEPTUALIZING HOW OTHERS BEHAVE: SOME OBSERVATIONS AND A PROPOSED THEORY

(L. C. Card No. Mic 59-582)

Helen Irene Snyder, Ph.D.  
University of Illinois, 1958

A series of interviews with withdrawn subjects gave evidence of a systematic difference between types of withdrawn persons in their inferences about the reasons for others' behavior. The type which consistently described others' reasons as efforts to achieve autonomy of the Self was called adaptive; those who perceived others' behavior as efforts to achieve congruence with the Other were called maladaptive.

A preliminary theoretic formulation was undertaken to account for this difference and to encompass another classification called aggressive. Two basic structures of the personality were described as instrumental in selecting behavior: the belief system and the need system. The belief system involves the residual data of past experiences of the individual, those of others he has known about, and the general cultural precepts about behavior. These are arranged into act-outcome sequence by a process called construing the event.

The need system supplies the initiating data for the act from the related elements of Self-dominance, Self-satisfaction, and cultural approval. Any of these may be negative rather than positive as a result of the identification-differentiation process. Because withdrawals are described as always experiencing cultural approval and aggressives as experiencing cultural approval, only two elements vary within groups; thus eight possible combinations of positive and negative elements of the need system can be derived, four withdrawn and four aggressive. These are called eight personality types.

The systematic difference observed in assessing the reasons for others' behavior is considered to be the result of these differences in need systems. To develop this, the processes of projection and of realistic perception of others and the principle of congruence were proposed. The observer was said to suppose, in the absence of contradictory information, that the observed person has the same reasons for so acting that he would have. However, the observer will rarely be without additional information in the form of cues from the observed person. He compares his projected need system with the cues he has from the observed for congruence. If all elements agree, he will infer a need system identical with his own. To the extent elements disagree, he will infer a need system which is ambiguous in one or more elements. Four levels of congruence are thus possible.

The rationale for an instrument to assess this is as follows. The inferred need system of other people will have a distinctive combination of positive and negative elements for each of the eight types. Therefore, if an item specifies the type of person described and the act-outcome



sequence he experiences, the observer will select that statement of the reason which reflects his inferred need system for such a person from among alternative reasons given. Each level of congruence will symbolize the inferred need system for each type by all types. Because the second and third levels each have three forms, there are eight distinctions possible in the levels of congruence.

When an item assesses two elements of the need system at once, fewer items are needed because sharper distinctions are possible. Under these circumstances, each item has three sets of four alternative reasons. Each set deals with two of the three elements of the need system and each alternative assesses two of the eight levels of congruence. This eighty-by-eight questionnaire has not been tested. However, two pilot studies used two-by-two versions of it. They produced results consistent with the hypothesis of systematic differences as applied to distinguishing adaptives from maladaptives although with small samples. Microfilm \$2.00; Xerox \$6.60. 139 pages.

**A STUDY OF ANXIETY AMONG ELEMENTARY AND SECONDARY EDUCATION MAJORS IN THE SCHOOL OF EDUCATION OF THE UNIVERSITY OF NORTH CAROLINA**

(L. C. Card No. Mic 59-61)

Paul Browning Walter, Ph.D.  
The University of North Carolina, 1958

Supervisor: W. D. Perry

This study is an investigation of anxiety among elementary and secondary education majors in the School of Education of the University of North Carolina.

The subjects for this study came from four groups: the secondary education majors and the elementary education majors enrolled in the teaching "block" in the School of Education of the University of North Carolina, a class in hygiene in the Physical Education Department of the University, and a class in Educational Psychology at the University composed of non-education majors. The experimental group was composed of 73 students, males and females, and the control group was likewise composed of 73 students, males and females. The main difference in the two groups and the focal point of the study was the fact that the experimental group was composed entirely of students planning to teach, and the control group of students not planning to teach.

The Minnesota Multiphasic Personality Inventory was selected as the instrument of measurement because it enjoys prestige and authority as a reliable predictor of human behavior. It is a psychometric instrument designed to provide, in a single test, scores on all the more important phases of personality. The instrument itself comprises 566 statements covering a wide range of subject matter, from the physical condition to the morale and the social attitudes of the individual being tested. The Inventory carries a built-in pattern for anxiety known as the Anxiety Triad. The triad is composed of the three scales, Hypochondriasis (Hs), Depression (D), and Hysteria (Hy). Together they form an excellent basis for determining excessive worry, immaturity, lack of insight, and emotional maladjustment.

The results of the Hypochondriasis part of the test revealed a mean in the experimental group of 51.17 with a range of 35 to 85, and a mean of 52.93 for the control group with a range of 33 to 78. The results of the Depression part of the test revealed a mean of 50.78 with a range of 25 to 90 for the students in the experimental group, and a mean of 53.62 with a range of 30 to 88 for the group of students tested in the control group. The results of the Hysteria part of the test revealed a mean in the experimental group of 55.89 with a range of 35 to 80 and a mean of 58.37 for the control group with a range of 45 to 78. The spread revealed in the frequency distribution tables is significant enough for comment. It signifies that although the mean for both the experimental and control group was quite normal, there are deviates in both directions. For Hypochondriasis, we have a  $t$  of 1.34, which is significant only at the 18 per cent level. On the Depression scale, the  $t$  is 1.54, which has significance at the 13 per cent level. On the Hysteria scale, the  $t$  is 1.86, which is again significant at the 6 per cent level. In all cases, the  $t$  test was a two-tail  $t$  test with 144 degrees of freedom. The standard deviations were as follows: Hypochondriasis, experimental group 8.08; Hypochondriasis, control group 8.94; Depression, experimental group 11.46; Depression, control group 11.02; Hysteria, experimental group 7.69; Hysteria, control group 7.54.

Statisticians regard significance at the 6 per cent level which we have for the total of the three scales combined a fairly safe indication that a real difference does exist between the experimental and control groups, but whether this difference is large enough to be of practical concern is another matter. The general conclusion along these lines in this particular case would be that there are slight differences between the groups, but that even if there are, they do not seem to be great enough to be particularly meaningful. Microfilm \$2.00; Xerox \$5.80. 116 pages.

**AN INVESTIGATION OF THE RELATIONSHIP OF COUNSELING TO STUDENT OUTCOMES IN A HOW TO STUDY COURSE**

(L. C. Card No. Mic 59-1307)

Garry Richard Walz, Ph.D.  
University of Minnesota, 1958

Adviser: Willis E. Dugan, Co-Adviser: C. Gilbert Wrenn

The main concern of this investigation was to discover if students who received instruction in a How to Study course plus counseling exhibited superior study skills at the end of training compared with students who received the course instruction alone. Two additional questions were also investigated: (1) Are study skills outcomes for the counseled and non-counseled students related to academic aptitude level? (2) Do how to study trained students exhibit latent learning as measured by a one-quarter's follow-up?

The population consisted of all University of Minnesota students who enrolled in a morning section of How To Study in the Winter Quarter of 1957. Students were randomly assigned to either a non-counseled group (control,  $N = 39$ ) or a counseled group (experimental,  $N = 39$ ). Both counseled and non-counseled students received course instruction using an eclectic teaching method which borrowed



from both the student-centered and instructor-centered approaches. The broad outlines of the course were instructor determined while the emphasis given to different topics and individual projects were student determined. The course had three main phases: 1) a diagnostic phase where through tests, class discussions, and individual projects the student was assisted in arriving a realistic understanding of his study behavior; 2) an introduction to superior methods of study; 3) guided practice in the use of the new study methods. Evidence was presented to show that all students regarded the class setting as informal with a close feeling between instructor and students and where individual help was easily obtained.

The counseled students received the same instruction as did the non-counseled plus three counseling conferences during the quarter. The conferences were an adjunct to the course and timed to assist the student at three critical junctures in the course: 1) when he was endeavoring to realistically appraise his study behavior; 2) after he was introduced to the new study methods and had used them in his studies; 3) at the end of the quarter when he reviewed his progress. The conferences were characterized by three main dimensions: problem solving, skill improvement, and motivational emphasis. The instructor's role was that of assisting each student in arriving at a workable study plan. It was important that the student regard the plan as his own and be motivated to assume responsibility for seeing it through to completion.

The two criterion measures were the Survey of Study Habits and Attitudes (SSHA), a study skills inventory with an attitudinal emphasis, and the Learning Practices Inventory (LPI) with an emphasis on specific learning methods. The Cooperative Reading Comprehension Test was used to equate post-test scores for initial differences in reading. The ACE was used as a measure of academic aptitude.

Analysis of variance and covariance and Fisher's *t* were the primary statistical tools. The results obtained were:

1. A significant difference between counseled and non-counseled males in study behavior, as measured by the SSHA, at the end of the instructional period. The difference was in the direction of more effective study methods by the counseled.
2. A suggestion of latent learning for non-counseled males was obtained on the LPI, as shown by more effective study habits a quarter after the course than at the conclusion of the course.
3. No significant differences in study behavior were noted in relation to level of academic aptitude.

It would seem that for this population and counseling-teaching situation three counseling conferences did significantly improve male report of study behavior over what was obtained in a student assistance oriented class alone. Additionally, it appeared that non-counseled males continued to improve their study behavior after they completed a How to Study course.

Microfilm \$2.15; Xerox \$7.60. 164 pages.

## EDUCATION, TEACHER TRAINING

### THE RELATIONSHIP BETWEEN PSYCHOLOGICAL DISTANCE AND EFFECTIVE TASK PERFORMANCE

(L. C. Card No. Mic 59-498)

Robert Harris DeZonia, Ph.D.  
University of Illinois, 1958

#### The Problem and Its Research Background

The major purpose of this study was to ascertain the relationship between a person's tendencies to differentiate between others and his effectiveness at performing a task.

Fiedler's<sup>1</sup> work with the Assumed Similarity between Opposites (ASo) measure was selected as a foundation for the study. The ASo score indicated the degree to which a subject differentiated between others in describing them on a 20-item, six-point adjective scale. High ASo scores indicated considerable differentiation and "psychological distance." Low ASo scores indicated slight differentiation and a correspondingly slight "psychological distance."

Fiedler found that sociometrically endorsed leaders of effective groups maintained considerable psychological distance between themselves and group members. Marse<sup>2</sup> extrapolated Fiedler's findings to the college campus and found that better college teachers also tended to maintain considerable psychological distance from others.

#### Subjects and Research Method

The subjects were: 117 male and female secondary school student teachers of the University of Illinois and 84 adult males who were members of bowling teams in Champaign-Urbana, Illinois. The relevance of the first group to the work of Marse is noted. The second group served as a check on the generality of findings regarding individual effectiveness and psychological distance. This large group also was used to follow up the findings -- limited in their usefulness by a small sample -- of a pilot study.<sup>3</sup>

Subjects furnished descriptions of "opposites" with whom they worked by checking the six-point scale. The descriptive profiles obtained were compared by the "d-statistic" originated by Osgood<sup>4</sup> and Cronbach and Gleser.<sup>5</sup> The "d," or ASo, score indicated the perceiver's degree of psychological distance. Student teachers filled out one form relating them to a general work situation, another relating them to the student teaching experience. Bowlers filled out a specific form only.

In tests of two hypotheses "best" and "poorest" student teachers representing the upper 15 per cent and lower 15 per cent, respectively, of student teachers in subject matter areas, were studied. College supervisors provided subjective ratings of teaching effectiveness. End-of-season bowling averages provided an objective criterion of bowling effectiveness. The criterion of group effectiveness was the proportion of games won by a team.

#### Findings and Conclusions

Findings were: (1) the relationship between effective bowling and bowlers' tendencies to differentiate between others was low, positive ( $\rho = .283$ ), and statistically significant ( $P < .01$ ); (2) the distributions of ASo scores of



"best" and "poorest" teachers did not differ in central tendency; (3) ASo scores of student teachers failed to correlate with ratings of effectiveness in most subject matter areas; (4) ASo scores of "poorest" student teachers increased in magnitude from a general to a teaching situation ( $P < .01$ ); the magnitude of changes in "best" teachers' scores was not significant ( $P < .66$ ); (5) in terms of stability of rank-order over situations "poorest" teachers were more stable ( $\rho = .772$ ,  $P < .01$ ) than "best" teachers ( $\rho = .383$ ,  $P < .10$ ); (6) sociometric choice status and ASo scores were unrelated in the bowling teams; and (7) ASo scores of informal leaders of bowling teams were not related to the criterion of group effectiveness.

It was concluded that the relationship between a high degree of psychological distance and individual effectiveness at task performance could not be generalized; also that the ASo measure appeared promising as a method of differentiating between better and poorer student teachers. Additional research was recommended in school situations to clarify further the relationship between psychological distance and effective teaching.

Microfilm \$2.00; Xerox \$5.20. 103 pages.

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2. Marse, J. E. Unpublished Research, Department of Psychology, University of Illinois, 1957-58.
3. DeZonia, R. H. Relationships between assumed similarity, sociometric choice, and skill level in a case study of effective and ineffective bowling teams. Unpublished research, University of Illinois, 1957.
4. Osgood, C. E., Suci, G. J., and Tannenbaum, P. H. The Measurement of Meaning. Urbana, Illinois, University of Illinois Press, 1957.
5. Cronbach, L. J., and Gleser, Goldine. Assessing similarity between profiles. Psychol. Bull., 1953, 50:456-473.

#### DEVELOPING AND USING AN OBJECTIVE INSTRUMENT TO MEASURE STUDENT GROWTH IN COLLEGE ELEMENTARY SCHOOL SCIENCE COURSES

(L. C. Card No. Mic 59-795)

Miles Harvey Esget, Ed.D.  
University of Colorado, 1958

Supervisor: Associate Professor James R. Wailes

It was discovered, after a survey of related literature, that no objective instrument at the college level was available for measuring achievement of content material in elementary school science. The original test developed was composed of one hundred fifty-six multiple-choice items and was later reduced to seventy-eight such items. Twenty-six of these items were of the problem situation type. The test was subjected to careful item analysis, and validated by expert judgment which resulted in increased test reliability and validity. The test, as used in research testing situations, had an estimated reliability coefficient of .96 according to Spearman-Brown Formula.

The test was used as a basis for determining student

growth of prospective elementary school teachers. The problem was to determine how two methods of teaching a college course in elementary school science would affect the level of subject matter achievement. The two teaching techniques involved were a methods course and a combined content and methods course. Course classification was determined from college catalogs and description of aims of the course by their college instructors. The investigation was relegated to state institutions of higher learning in Colorado preparing elementary school teachers. At these schools prospective elementary school teachers were given tests before as well as after taking a college course in elementary school science. A group of elementary school teachers were used in order to have a basis for comparison.

No significant differences were found among student groups from four state teacher training institutions in Colorado at the time of the pretests. However, when tested again at the completion of courses emphasizing method and content, the differences were significant at the .001 and .01 levels. The differences were in favor of the students given a science course emphasizing content with some methods of teaching.

When training includes both elementary science content and method, the prospective teacher with such a course has a better command of elementary science facts and understandings than does the prospective teacher given training in teaching methods. Science facts and understandings possessed by certain in-service elementary school teachers, as measured by an objective test, are at a much higher level than those possessed by students preparing to teach. However, after prospective elementary school teachers took a combined methods and content course, their achievement level was similar to that of the in-service teacher at the time of the pretest.

The significance of the study was that of solving two problems in the field of elementary school science. The first was the need for a test at the college elementary science level. The other was to reinforce or reject hypotheses that there were no significant differences among pretest or re-test means for student groups from four state teacher training institutions in Colorado. In the case of the pretest differences the null hypothesis was not rejected, whereas in the case of the re-tests the null hypothesis was rejected. This indicated, in rejecting the null hypothesis, that differences in student growth were significantly different in favor of a combined college course in method and content in elementary school science as compared with a methods course only.

Microfilm \$2.00; Xerox \$7.00. 150 pages.

#### THE IDENTIFICATION OF CERTAIN COMPETENCIES IN TEACHING VOCATIONAL HOME ECONOMICS IN THE SECONDARY SCHOOLS OF MISSOURI

(L. C. Card No. Mic 58-5239)

Pauline Bertie Gillette Garrett, Ed.D.  
University of Missouri, 1958

Supervisor: Ralph K. Watkins

**PURPOSE OF STUDY:** The major purpose of the investigation was to identify certain competencies in teaching



vocational home economics in secondary schools of Missouri and to determine the relationship between placement of teachers in categories of Unusually Competent, Competent, and Inadequate, and certain identified competencies.

**METHOD OF RESEARCH:** Three methods of procedure were used to obtain information. An instrument including the criteria; Organization and Planning; Department Appearance and Care; Relations with Pupils-Class Interest; Home Experience Program; Extra-Curricular Cooperation; Community Participation; Variety in Teaching Techniques; Use of Current Materials and References and Carry-Over in Enrollment, was used to record data made available in the State Department of Education. Based on an interpretation of the data, the investigator placed the teachers in categories of Unusually Competent, Competent, and Inadequate.

A second instrument including the criteria: Philosophy; Personal Qualities; Leadership; Professional Qualities; and Management was used by teachers and administrators for evaluating each teacher.

A third instrument encompassing curricular offerings suggested in a vocational home economics program and including a list of certain competencies with respective levels of behavior was checked by teachers. The list of competencies and levels of behavior had been agreed upon by a jury of home economics education specialists.

**SUMMARY:** The following statements were descriptive of the one-hundred and fifty-one teachers who participated in the study:

They represented 47.4 per cent of all the vocational home economics teachers in the state. Teachers with three years or more teaching experience in their present location participated in the study.

There were some teachers from each of the three categories in Class A, AA, and AAA, type schools.

There were some teachers from each of the categories who had received their training out of the state and some who had received their training in Missouri.

Neither the Inadequate, the Competent, nor the Unusually Competent teachers seemed to follow a definite trend to indicate that the Unusually Competent teachers had accumulated more hours in home economics, more hours in professional education, nor more total collegiate hours, than the Inadequate teachers.

There did not seem to be any particular pattern concerning years of experience and placement in a particular category.

It appeared that the nine items on the one instrument including Organization and Planning, etc., did help to differentiate the Unusually Competent from the Inadequate but did not differentiate the Competent from the Unusually Competent teachers.

The aspects of teacher qualification on the second instrument concerning Philosophy, etc., had some but limited and vaguely defined relationship to selected statements of competency.

Of the twenty-eight statements of competency which were discriminatory statements in differentiating the

Inadequate from the Competent and the Competent from the Unusually Competent, there were eight statements from the "Foods" area, five from "Clothing," four from "Planning," two from "Management," and three from each of the areas, "Health," "Human Relationships," and "Housing."

Seven of the statements differentiated the Inadequate from the Unusually Competent but did not differentiate the Competent from the Unusually Competent. Eleven of the forty-six statements of competency did not differentiate the behavior of the groups of teachers at all.

An example of a statement of competency which was not discriminatory with any of the three levels of behavior was:

Demonstrate, promote and maintain acceptable standards of individual and group conduct.

An example of a statement of competency which was helpful in differentiating the Inadequate from the Unusually Competent was:

Emphasize grooming and health habits.

An example of a statement of competency which was helpful in differentiating the three groups of teachers was:

Utilize appropriate evaluation procedures in appraising growth of home economics students.

Microfilm \$5.50; Xerox \$19.20. 430 pages.

## A STUDY OF THE COMPETENCIES OF UTAH JUNIOR HIGH SCHOOL MUSIC TEACHERS

(Publication No. 20,199)

Farrell D. Madsen, Ed.D.  
University of Oregon, 1957

Adviser: Robert E. Nye

This study was undertaken because it was observed that there was no systematic study of Utah music teacher competencies available to give direction to the attempts of teacher-preparation and improvement agencies to meet a recognized need of teachers for assistance in teaching junior high school music.

The problem consisted of three parts, which were to determine, first, desirable music classes and activities for Utah junior high schools; second, the most important competencies for teachers of these classes and activities; and, third, in which of these competencies Utah junior high school music teachers were inadequate and thus needed assistance.

Music education literature regarding desirable junior high school music classes and activities was reviewed. A rating sheet was devised using the information obtained. This was sent to samplings of Utah junior high school music teachers and principals, school superintendents of the intermountain area, university and college music education personnel, and heads of professional music schools. Desirable types of music classes and activities were considered to be those that received ratings of one or two on a four-point rating scale from 50 or more per cent of each of these groups.



Similar methods were used to devise a second rating sheet regarding desirable competencies for junior high school music teachers. This rating sheet was used in interviews with twenty-one junior high school music teachers recommended as outstanding by leaders in music education in the Northwest. Very important competencies were considered to be those that received one or two ratings on a five-point rating scale from nineteen or more of these teachers provided that no fewer than thirteen were number one ratings.

A third self-rating and check sheet similar to the second was sent to all junior high school music teachers in Utah. Part of it was sent to all Utah junior high school principals also, so that their ratings of teachers could be compared to the self-ratings of teachers. It was assumed that there was considerable inadequacy among Utah teachers if 20 or more per cent of those who replied checked themselves as inadequate or rated themselves below two on a five-point rating scale.

The following items related to classes or activities considered desirable qualified to be placed in the very important category and were classed as inadequacies of Utah teachers:

Such items for all music teachers were (1) the personal characteristics of enthusiasm, resourcefulness, tact, pleasantness, and imagination, and (2) knowledge of units and materials for correlating music with other subjects.

Such items for instrumental teachers were (1) methods and techniques of teaching spontaneity and creative expression, advanced band and orchestra instruments in general,<sup>1</sup> beginning and advanced double reed and flute and percussion and string instruments;<sup>1</sup> knowledge of orchestra music,<sup>1</sup> string music,<sup>1</sup> music literature in general, arranging, keyboard harmony; and (3) ability to perform simple music on a string instrument.<sup>1</sup>

Such items for vocal music teachers were (1) knowledge of music literature, arranging, and boys chorus music; and (2) ability to sing expertly.

Such items for general music teachers were (1) methods and techniques of motivation and of correlation of music with other classes and (2) knowledge of audio-visual aids in general, opaque and other projectors, films, lists of songs about various places and things and activities, standard series books for general music, daily plans and music units, and history of music.

Principal conclusions and recommendations based upon the criteria adopted were that:

1. Utah junior high schools should offer the classes and activities placed in the desirable category.
2. Junior high school music teachers should have the competencies classed as very important.
3. Teacher preparation and improvement agencies should assist prospective teachers to acquire these competencies.
4. Considerable numbers of Utah music teachers were inadequate in many of the very important competencies for teaching desirable classes.
5. Utah teacher-improvement agencies should give immediate attention to helping teachers acquire these competencies.

Microfilm \$2.65; Xerox \$9.20. 203 pages. Mic 58-5230.

1. Symphony type orchestra, the only class using string instruments, was classed as desirable for large schools and as neither desirable nor undesirable for small schools.

## A FOLLOW-UP STUDY OF INSERVICE GRADUATES OF FARMINGTON (MAINE) STATE TEACHERS COLLEGE

(L. C. Card No. Mic 59-689)

John Emerson Mudge, Ed.D.  
Cornell University, 1958

Chairman: A. Gordon Nelson

The two-fold purpose of this study was to obtain information which would be helpful in the current curriculum revision and to examine the attitudes and needs of alumni in terms of inservice education.

Data pertaining to the evaluation of the College curricula were obtained from the alumni by means of a checklist inquiry form. The form also sought information about the graduates' attitudes, background, and self-estimates of teaching success. The questionnaire included open-end questions for soliciting original comments about the Farmington program. A second inquiry form was mailed to the employers of the teaching alumni who were invited to estimate the proficiency of the teachers, to express their views concerning inservice education and to discuss other problems relative to teachers in the field. Grade-point averages were computed from the College register.

Five-step rating scales were employed for evaluating teaching proficiency. Because of its adaptability to this type of scale, Pearson's coefficient of mean-square contingency ( $r_c$ ) was applied to the data. Formal courses and activities were rated by the index-score method.

The participants in the study were 166 (78%) of 212 teaching graduates of Farmington State Teachers College and 86 per cent of their superintendents. The alumni credited their choice of teaching to former teachers; only five per cent attributed their choice to high-school guidance counselors. Alumni who had participated in campus activities averaged to do less graduate study than those who had not participated. No significant differences were found in other group comparisons.

Graduates prefer the fellow-teacher to other kinds of orientation assistance. Academic help, when sought, was usually in science or the teaching of reading. Superintendents suggested "cultivating pupil interest" and "knowledge of the subject" as first and second among "special strengths" observed in Farmington alumni. Personality was rated the best criterion of teaching success. Poor discipline, lack of confidence, difficulty in planning, and subject-matter deficiencies were problems of new teachers.

A contingency correlation ( $r_c$ ) of .62 was found between the graduates' self-estimates of teaching proficiency and their employers' ratings. A coefficient of .40 was found between self-estimates and grade-point averages in college. Correlations of other factors produced similar values. The laboratory-school experience and child and curriculum were rated the most useful courses in the professional curriculum; however, respondents recommended strengthening the latter in the areas of mathematics and science and preparation for service in higher grades. The physical sciences received more "unimportant" ratings than did other subjects; alumni rated mathematics highest.

The respondents' reactions to the professional curriculum took the form of recommended changes while their criticisms of arts courses were requests for more content and a re-evaluation of subjects with respect to content emphasis.



Some resulting conclusions are:

1. Professional attitudes of teachers are poor.
2. Discipline and lack of understanding of school's philosophy are prevailing difficulties of the beginning teacher.
3. Supervisors and teachers agree that teacher orientation is important but they disagree on the procedure.
4. The "real" experiences of the beginning teachers cause disillusionment after the "ideal" training situation.
5. The laboratory experience provides too little actual classroom responsibility.

The findings suggest the need for more information about the socio-economic backgrounds of prospective students, earlier interviews of applicants, an examination of the problems of professional status and interest, the services of a field consultant, knowledge of techniques employed by alumni of other colleges to guide high-school graduates into teaching, a continuing analysis of the curricula in terms of changing needs and duplication, and a longitudinal study of the follow-up type.

Microfilm \$2.80; Xerox \$9.60. 213 pages.

#### THE TECHNICAL INSTITUTE MOVEMENT: A STUDY AND PROJECTION OF THESE PROGRAMS IN AMERICAN HIGHER EDUCATION

(L. C. Card No. Mic 59-413)

Charles Wellington Phallen, Ph.D.  
The Ohio State University, 1958

The purposes of this inquiry have been to examine the nature of the technical institute; to collect and correlate opinions, facts and philosophies reflecting the status of this type of program; to investigate the needs of American industry; to outline the place of the Technical Institute in American education; and to outline the organization and projection of this type of higher education.

The dissertation has been undertaken to help place the technical institute in proper perspective with allied areas of American higher education. Furthermore, the long range objective has been to provide a guide for the development of programs which will help meet the technical needs for technicians in industry in proportion to the technical man power needs of this nation. The findings suggest the following recommendations:

1. The continued shortage of technicians in industry warrants a greater expansion of technical education above the high-school level.
2. More facilities are needed for training technical institute teachers and administrators.
3. Textbooks are urgently needed on the technical institute level.
4. State boards of technical education should be established in each state.
5. The community college should be considered as an important aspect of the institute program.
6. Technical institutes should let secondary school counselors know more about their work.

7. The curriculums of technical institutes should be better balanced by including more general education.

8. There is a need to establish better relations with industry in many areas of Institute work.

9. Technical education needs to be made more available locally, because most cities of 50,000 population or more could support a technical school.

10. Whenever possible, technical schools should have an evening department as one of their objectives.

11. Technical-school graduates should receive nationally recognized credentials.

12. There is an increasing need for existing technicians to improve or to obtain higher status.

13. Better use should be made of technical personnel.

14. Greater financial assistance is needed.

15. More qualified teachers with technical specialties are needed.

16. Industry should give financial aid to worthy students.

17. Annual national statistics of status and trend are needed.

18. A technical institute specialist is needed in the U. S. Office of Education.

19. The coordination of institute programs is desirable.

20. Private institutes need additional revenue.

21. A master plan is needed to supplement technically trained manpower sources.

22. A plan to upgrade technical personnel is needed in industry.

23. Technical societies should aid technicians.

24. The standing of Technical Institute programs must be built up to a status at least equal to that of any other higher education program.

The increased complexity of technology demands that more technicians be prepared to support industry. Furthermore, to provide the nation with the needed technicians in the foreseeable future will require intelligent planning both by industry and the schools. Thus a method must be found to develop the necessary personnel and apply it with skill and diligence. Only in this way can a highly developed industrial nation continue to grow. Such is the problem and the outcome of the dissertation.

Microfilm \$2.60; Xerox \$9.00. 198 pages.

#### EDUCATION, THEORY AND PRACTICE

##### A STUDY OF THE EFFECTIVENESS OF THE PROBLEM METHOD AND THE TEXTBOOK-DISCUSSION METHOD IN ELEMENTARY SCIENCE INSTRUCTION

(L. C. Card No. Mic 59-824)

Regan Carpenter, Ed.D.  
University of Colorado, 1958

Supervisor: Associate Professor James R. Wailes

The purpose of this study was to compare the effectiveness in elementary science instruction of a method of teaching based upon demonstration and classroom experimentation (Problem Method) with that of a method based upon reading and discussing a basic textbook (Textbook-discussion Method).

The experimental portion of this study was conducted in Honolulu, Hawaii. All of the fourth-grade pupils (323)



in three non-public elementary schools were divided into two groups (A and B). These groups were equated upon the basis of intelligence test scores, age, and sex. The teachers in the two groups were also equated, on the basis of education, experience, and rating of administrators.

"Magnets," a topic from the area of physical science which is commonly taught in elementary schools, and "The Adaptations of Animals--Excluding Man," a topic from the area of biological science which is commonly taught in elementary schools, were the two science topics selected for use in the experiment. A comprehensive, detailed teaching unit was constructed for each topic. These units coupled with numerous demonstrations and explanations familiarized the participating teachers with the Problem Method. They were already familiar with the Textbook-discussion Method.

The pupils in Group B studied "Magnets" by the Problem Method while those in Group A studied the same length of time by the Textbook-discussion Method. The same objective test (previously constructed and validated by the writer) was administered to both groups, and the mean scores achieved were compared through the use of the *t* technique.

Then the roles of the groups were reversed. The pupils in Group A studied "Animal Adaptations" by the Problem Method while those in Group B studied the same length of time by the Textbook-discussion Method. Again the mean scores were compared by means of the *t* test.

#### Results of the Experimentation:

1. In each instance the group which was taught by the Problem Method achieved a mean score significantly superior to that achieved by the group which was taught by the Textbook-discussion Method. Regarding the study of "Magnets," the null hypothesis of no real difference between the population proportions of the two variables must be rejected at the .05 level of significance. Regarding the study of "Animal Adaptations," the null hypothesis must be rejected at the .02 level of significance.
2. The pupils ranked highest in general scholastic ability were less influenced by the change in teaching methods than were the other pupils. In the study of both topics, the academically high-ranking pupils taught by the Problem Method achieved a higher mean score than did those taught by the Textbook-discussion Method, but the difference was not statistically significant.
3. The pupils ranked lowest in general scholastic ability were significantly influenced by the change in teaching methods.
4. A majority of the pupils interviewed preferred the Problem Method of teaching.
5. Five of the six participating teachers preferred the Problem Method to the Textbook-discussion Method.

#### Conclusions:

1. The Problem Method is superior to the Textbook-discussion Method in teaching science at the elementary level.
2. A majority of elementary pupils prefer the Problem Method to the Textbook-discussion Method.
3. The findings of this study indicate that elementary teachers enjoy teaching by the Problem Method.

4. The findings of this study indicate that the Problem Method is of real value in teaching science facts to elementary pupils who are low in scholastic ability.

5. Further research is needed to extend this type of experimentation into other geographic areas, other subject-matter areas, and other grade levels.

6. Further research regarding the development of desirable science attitudes is needed.

Microfilm \$2.20; Xerox \$7.80. 168 pages.

### DESIGN COMPETENCIES OF BEGINNING STUDENTS IN WOODWORKING

(L. C. Card No. Mic 59-605)

Robert Irving Johnson, Ph.D.  
University of Minnesota, 1958

Adviser: Dr. William J. Micheels

#### I. PURPOSE

This study sought to identify special problems which students face in designing their own projects and to explore suitable teaching techniques which promote experimental research in project design. Two principal hypotheses were tested: 1. The beginning student in industrial arts woodworking is willing to accept individual responsibility for originating and planning his projects; and 2. The beginning student in industrial arts woodworking can start independent project planning successfully at the beginning of his first term.

#### II. PROCEDURE

Two sections in an introductory woodworking class for prospective elementary teachers with little or no woodworking experience, at the University of Minnesota, spring, 1957, constituted the samples. Additional sections taught the previous and following quarters helped to confirm certain findings and to establish the representativeness of the spring, 1957, samples.

Instructional materials, specially developed for the study, stressed a problem approach to project planning; emphasis was placed upon application of principles of good design. Each instructor followed his usual instructional procedures except for use of these materials. A given order of presentation provided a satisfactory degree of uniformity in project procedures.

Information about outcomes was obtained by use of pre- and post-tests of subject-matter information, personal information sheets for student responses, daily anecdotal-type instructor diaries, periodic written student reactions, individual folders of work-note for each and a photographic record of projects. This information was analyzed by statistical procedures when appropriate student and instructor reactions were synthesized and student projects produced from their own plans appraised for design.

#### III. FINDINGS

1. Both hypotheses were supported. Beginning students were generally willing to accept responsibility for



developing project plans and were able to work out original plans which reflected the instruction provided them in design. Most students were able to work independently in this manner relatively early in the course.

2. The instructional materials prepared for the study were well received by the students and these apparently provided the necessary motivation needed to develop project plans of their own. These materials, based on a problem solving approach, encouraged beginning students to alter pre-structured project ideas at first and later to develop original planning along lines of functional design. The instructional student guide sheets illustrated that appealing project ideas could be drawn from a variety of problem situations.

3. The usual subject outcomes were obtained as well or better when special instruction in project design was added. Simultaneously all students were successful in producing original projects of their own design. These projects were quite consistently of good quality and showed a simplicity and originality not usually found in student efforts at this level.

4. Both student and instructor reactions were generally favorable to this approach to the teaching of project planning. Many students became quite enthusiastic about their participation in planning and the projects which they created.

#### IV. CONCLUSIONS

1. Students in woodworking should be encouraged to begin project planning early and to develop tool skills and other desired outcomes in conjunction with the execution of these projects.

2. The problem solving approach is effective in the development of instructional materials for project planning. Additional materials of this sort should be developed for industrial arts teachers both in woodworking and in other areas.

3. Students should be stimulated in contemporary design through instruction in design as problem solving and through exposure to simple basic examples of geometric simplicity in project construction.

4. The present study has demonstrated some of the difficulties inherent in research on project design and also the need for additional effort to clarify some of the major factors influencing creativity in design. Apparently, industrial arts is a good field in which to do such research.

Microfilm \$4.00; Xerox \$13.60. 311 pages.

#### CHILDREN'S METHODS OF PROBLEM SOLVING IN ARITHMETIC

(L. C. Card No. Mic 59-242)

Richard Stanley Leno, Ed.D.  
Stanford University, 1958

The purpose of this study was to determine whether children may have ways of arithmetic problem solving and of explaining their ways or techniques which can be identified and which may have greater usefulness for some children than some of the problem solving methods devised and taught by adults.

The background of the study was developed from an examination of the literature in children's thinking and the teaching of problem solving. Four different classes of studies were identified.

The procedure used in the investigation was the comparison of the gains of matched groups under controlled conditions. A total of 886 children was tested. The members of each group were given Test 2 of the Brownell-Sueltz test, *Functional Evaluation in Mathematics*. Pupils of the experimental group were interviewed individually after the test to determine ways in which each pupil solved his problems. Pupils of the second group analyzed their ways of problem solving according to a way devised by the investigator, in order to provide a situation similar to the experimental situation as an additional control for the experimental group. The pupils of the third group were used as the control group. The problem solving methods of the experimental group were analyzed and categorized, and the experimental method derived from these statements was then taught to the experimental group. The members of the second group were taught a standard method devised by the writer. After the administration of the alternate form of the test all the children for whom complete data were available were divided into matched triads, with one member in each of the groups mentioned above.

The data were analyzed by grade level, by chronological age, and by mental ability. In no grade, chronological age level, or mental ability level was there a consistent indication that the experimental method of teaching problem solving gave significantly greater gains than were obtained in either of the control groups. All groups made gains that were approximately five times greater than normal expectancy for the elapsed time. The fact that approximately equal gains were made in all groups suggests that whatever factors contributed to these gains were not applied solely to the experimental group.

Possible factors which may have contributed to the observed gains were: stimulus of the experimental situation, above average competence on the part of the participating teachers, and the good socio-economic conditions of the neighborhoods from which the children came.

One of the findings that was clearly apparent in the study was that the pupils in all groups made gains that were significantly greater than could have been expected for a similar length of time under non-experimental conditions. Although the factors that caused these gains were neither isolated nor even identified in the study it seems probable that similar gains could be achieved by other groups of pupils by reproducing the conditions established in this study.

Microfilm \$2.00; Xerox \$6.40. 131 pages.

#### A STUDY OF CURRENT PRACTICES IN THE TEACHING OF LATIN IN THE PUBLIC HIGH SCHOOLS OF THE STATE OF ILLINOIS, 1956-57

(L. C. Card No. Mic 59-215)

Joan Marie Madsen, Ph.D.  
Northwestern University, 1958

Supervisor: William G. Brink

The purposes of this study were (1) to determine the status of Latin in the public high schools of Illinois in



respect to enrollments, offerings, objectives, instructional activities, methods, and textbooks; (2) to appraise current practices on the basis of the Classical Investigation and the Committee on Educational Policies of the Classical Association of the Middle West and South as well as certain criteria found within this study by correlation of activities and methods with stated objectives; (3) to determine the professional preparation and activities of teachers of Latin; and (4) to discover trends in the teaching of Latin.

The general procedure used in the study was the descriptive-survey. One source of information was the Illinois School Directory, 1956-57, and its supplement, Illinois Secondary Teachers; the other source was the teachers of Latin and the principals who responded to a questionnaire sent to all public high schools as listed in the above publications.

These publications revealed that there were 691 public high schools in Illinois in 1956-57, of which 397, or 57.45 per cent, offered Latin in their curricula. However, these 397 schools enrolled 80.57 per cent of the total public high school enrollment.

Four hundred seventy-four, or 68.60 per cent, of the public high schools responded to this study in time for tabulation of data. In the 471 schools furnishing detailed information on enrollments, the total school enrollment was 231,468 students of whom 19,022, or 8.22 per cent, were enrolled in Latin courses. Of those schools which offered Latin in their curricula, 68.11 per cent offered only two years of Latin and 26.77 per cent offered advanced Latin. Eighty-seven high schools offered only Latin in their foreign language curricula; 93 offered Latin plus one other foreign language; 39, Latin plus two other languages; 31, Latin plus three other languages; 2, Latin plus four other languages; 2, Latin plus five other languages; 79 offered no Latin but some other foreign language(s). A majority of principals indicated that they had observed definite increases in foreign language enrollments in their schools since 1951-52.

Sixty-five per cent of the teachers of Latin were between the ages of 40 and 59; 15 per cent were 60 or older; 20 per cent were 39 or younger. The median of their years of experience in teaching Latin I was 14.24 years. Well over half of the teachers had studied Latin four years in high school and well over half had studied Latin four years as college undergraduates.

This study revealed that the teachers of Latin in Illinois favored objectives, instructional activities, and methods leading to increased understanding of English; comparatively little stress was given to comprehension of Latin as Latin. The three objectives which were rated as stressed very much by the great majority of teachers were increased understanding of English words derived from Latin, increased understanding of elements of English grammar related to Latin, ability to translate from Latin to English orally. The classroom activities and methods favored by the large majority of teachers were consistent with such objectives. However, within the selection of methods there was some inconsistency since about one-third of the teachers reported diametrically opposed procedures as those used predominantly. The translation method was used predominantly by 68.78 per cent of the teachers; the translation-grammar method, by 53.59 per cent; the grammar-translation method, by 42.61 per cent. In general, the teaching of Latin appeared to remain static in its stress upon translation and grammar rather than

upon the reading method and socio-cultural objectives vigorously proposed by learned opinion since the Classical Investigation of 1921-24.

Microfilm \$2.75; Xerox \$9.60. 211 pages.

#### THE RELATIONSHIP OF AUDITORY DISCRIMINATION TO SPELLING ACHIEVEMENT AT THE COLLEGE FRESHMAN LEVEL

(L. C. Card No. Mic 59-243)

Ned Deland Marksheffel, Ed.D.  
Stanford University, 1958

This study investigated the relationship between spelling competence and auditory discrimination at the college freshman level.

Four hundred and forty-four freshman students were given tests of auditory discrimination and spelling. The subjects were divided into three groups on the basis of spelling test scores. The mean differences, and coefficient of correlation of the measure between the high and low groups of spellers were computed and tested for significance. The significance of the mean difference was tested, using the .05 level of significance.

The criterion measure for spelling achievement was the Traxler High School Spelling Test, Form 1. The measure for testing auditory discrimination, based upon words, was designed by the examiner. The measure of intelligence was the American Council on Education Psychological Examination, 1952 edition.

The test of auditory discrimination did not significantly differentiate between high and low spelling groups at the .05 level or better. There was a significant relationship, .01 or better, between auditory discrimination and intelligence for all students tested. There was no significant sex difference between intelligence and spelling at the .05 level or better.

#### Conclusions

1) The ability to discriminate between likenesses and differences in the sounds of words does not appear to influence the spelling achievement of college freshman students.

2) Sex differences appear to have no effect upon the relationship between spelling achievement and auditory discrimination.

3) There appears to be a significant relationship between intelligence and auditory discrimination for college freshman. There is a significant relationship for male students but not for female students. This is a tentative conclusion and needs to be further tested since the general case is that there is a significant relationship at the .01 level or better.

4) Intelligence is a significant factor in spelling achievement for college freshmen.

Microfilm \$2.00; Xerox \$4.80. 91 pages.



**A PRE-FIRST-GRADE ORAL-ENGLISH PROGRAM  
AS RELATED TO THE SCHOLASTIC  
ACHIEVEMENT OF SPANISH-SPEAKING CHILDREN**

(L. C. Card No. Mic 59-802)

Guy Brett McNiel, Ed.D.  
University of Colorado, 1958

Supervisor: Associate Professor Helen Kyle

The purpose of this investigation was to study the effect of a pre-first-grade oral-English program upon the scholastic achievement of Spanish-speaking children in the elementary grades. The philosophy, English vocabulary, and teaching principles that formed the basis for the oral English program conducted in El Paso, Texas, and used in this study were developed in the summer of 1946 in a curriculum workshop under the sponsorship of the Office of Inter-American Affairs and the Texas College of Mines.

A number of investigations have produced evidence indicating that a large proportion of Spanish-speaking children in public schools of the Southwest are commonly retarded from one to two years in their scholastic achievement when compared with English-speaking pupils. The most obvious handicap of the beginning Spanish-speaking child in school is his inability to speak and understand English.

This study sought an answer to the question of whether the scholastic achievement of Spanish-speaking children could be accelerated through the operation of the pre-first-grade oral-English program. The effect of the program upon children of superior, average, and below average intelligence was also studied. Control and experimental groups of Spanish-speaking children were established at grade levels three, four, five, and six in four elementary schools in El Paso where the membership is almost wholly Spanish-speaking. An intelligence test was administered in Spanish at grade one level to all of the pupils in the study. Subsequently, achievement tests were administered at grade levels three, four, five and six. Pupils in grade six in the study had been tested at grade one level with an intelligence test and at grade levels three and six with achievement tests. Pupils in grades three, four, and five had taken an intelligence test at grade one level and an achievement test at their stated grade level at the time the study was concluded.

The analysis of variance for the achievement scores in reading, arithmetic and language of grade three pupils after covariance adjustment for scores on the intelligence tests administered at grade one level showed significant differences in achievement in favor of the experimental group which had been subjected to the pre-first-grade oral-English program. Children in grade four who had received pre-first-grade oral-English training also achieved significantly higher than grade four pupils in the control group. In grades five and six no differences were found in the achievement scores of the control and experimental groups large enough to justify rejection of the null hypothesis at the established level. Differences in the achievement of children of superior, average, and below average intelligence in the control and experimental groups at grade six level were not statistically significant. One of the major findings of this investigation is that, although the effect of the pre-first-grade program of oral-English does not result in significant differences in achievement in reading,

arithmetic and language at grades five and six, there is evidence to support the theory that the scholastic achievement of Spanish-speaking children can be materially advanced through grade four by the operation of the pre-first-grade oral-English program. Future research should include achievement testing at higher grade levels of current grade three and grade four pupils of the present study to ascertain whether the differences found in the achievement of control and experimental pupils at these levels change. An effort should also be made to evaluate the effect of the pre-first-grade oral-English program upon pupil and teacher attitudes, upon home and school relations, upon the school adjustment of pupils, and upon health knowledge and skills.

Microfilm \$2.00; Xerox \$7.00. 148 pages.

**A STUDY OF DIFFERENCES AND RELATIONSHIPS  
BETWEEN EDUCATIONAL ACHIEVEMENT AND  
CLASS SIZE IN TWENTY-SIX SELECTED HIGH  
SCHOOLS IN THE ARCHDIOCESE OF LOS ANGELES**

(L. C. Card No. Mic 59-872)

Sister Mary Benedetta Miglionica, Ed.D.  
University of Southern California, 1958

Chairman: Professor Eduard H. LaFranchi

For a number of years high school administrators have sought to determine experimentally to what extent educational achievement in small classes compared with that of large classes. The purpose of this study was (1) to determine whether a significant difference existed between educational achievement in limited or varying large classes and in limited or varying small classes; (2) to determine the relations between class size and educational achievement in English, mathematics, social studies, and science.

**Findings.** Since the standardized and nonstandardized data presented established the fact that the two groups of classes initially did not differ significantly, the educational gains may be said to be the direct outgrowth of class size. There were 72 matched pairs of large and small classes. The mean gains favored the large classes in 40 pairs and the small in 32 pairs.

Regarding large classes, 19 matched pairs showed a significant difference at the 1 per cent level of confidence, 1 pair at the 5 per cent level of confidence, and 20 showed trend in favor of large classes. Regarding small classes, 11 showed a significant difference at the 1 per cent level of confidence, 3 at the 5 per cent level of confidence, and 18 showed trend in favor of small classes. The study revealed the superiority of the limited large classes over the varying large classes in that 24 of the 72 favored the limited large classes at the 1 and 5 per cent levels of confidence and trend. Findings regarding the varying large classes showed that only 16 matched pairs favored the varying large classes at the 1 and 5 per cent levels of confidence and trend. The study revealed the superiority of the varying small classes over the limited small classes in that 20 of the 72 matched pairs favored the varying small classes at the 1 and 5 per cent levels of confidence while only 12 favored the limited small classes at the 1 and 5 per cent levels of confidence and trend.



Chi-square evaluations were made to determine whether the superiorities of large and small classes in the 72 pairings were related to other factors. Data showed there were 40 instances in which large classes were superior, but this superiority was found in 24 of the 36 limited large classes and only 16 of the 36 varying large classes. Hence one finds a significant relationship, suggesting that the superiority of large classes is mainly to be found under the limited size conditions.

There were 26 paired tenth grade classes, 26 eleventh, and 20 twelfth grade classes. Were the superiorities of the large or small classes related to grade? The chi-square data indicate a significant relationship between the results and grade level, for the reader notes that the superiority of small classes is lodged mainly in the tenth grade, the superiority of the large classes mainly in the eleventh and twelfth grades.

**Conclusions:** The data do not permit drawing any firm conclusions, except that classes not in excess of 35 are apparently as successful as those 25 and below except in the tenth grade English.

**Recommendations.** (1) It is recommended that classes in English language be limited to 25 students. (2) It is recommended that classes in mathematics, science, and social studies need not be limited to 25 or fewer students. (3) It is recommended that further study be made to determine what variables were operating to cause the differences in the varying and limited classes.

Microfilm \$3.85; Xerox \$13.00. 297 pages.

#### CHILDREN'S USAGE OF PUNCTUATION AND CAPITALIZATION IN THE INTERMEDIATE GRADES

(L. C. Card No. Mic 58-5776)

James Zaphirios Polychrones, Ph.D.  
Northwestern University, 1958

**The purposes.** The purposes of the study were: (1) to examine and compare the relationship between intermediate grade children's test achievement in the use of punctuation and capitalization and their actual use of these skills in functional writing situations; (2) to ascertain the kinds of punctuation and capitalization errors made by the same children when using written language functionally; and, (3) to determine whether such children attempted to or tended to use functionally the skill forms studied before, at the same time, or after such forms were presented in three widely-used language textbook series.

**The procedures.** The text knowledge and functional usage data were obtained from a group of 360 somewhat culturally and geographically representative Chicago and suburban fourth, fifth, and sixth grade children possessed of 90-110 I.Q.'s. These children took the SRA achievement test in language arts, and they wrote résumés and original conclusions for the strip film, *Gulliver's Travels to Lilliput*.

Also as a part of the study, the 27 classroom teachers who worked with the 360 children were interviewed with respect to their language composition instruction. Because the interviews revealed a variety of techniques that were used in the teaching of language arts, it became apparent that it was impossible adequately to answer the study's third inquiry.

The children's functional writings were evaluated in

terms of basic, authoritatively compiled rules of punctuation and capitalization.

The data on achievement test scores and usage error quotients were compared to determine degrees of co-relation. A usage error quotient was defined as the ratio of the number of errors in punctuation and capitalization and the number of opportunities for error in the same.

Lastly, the kinds of punctuation and capitalization errors in written usage were identified, classified, and ranked in order of frequency.

**Some major conclusions.** Among the study's conclusions were the following:

1. The study group as a whole did not distinguish itself in the ability to write in a functional situation even when allowance was made for achievement test scores below national norms.
2. The group as a whole tended to do a relatively better job in capitalization than in punctuation.
3. Little co-relation was found between children's test knowledge and their actual usage of specific punctuation and capitalization forms.
4. The fourth grade children erred completely in functional usage with respect to certain uses of the comma, quotation marks, the question mark, the exclamation point, the hyphen, and the colon.
5. The fifth grade was completely successful in written usage with regard to the use of the question mark. The grade erred completely with reference to certain uses of the comma, the semicolon, and the dash.
6. Fifth grade pupils made perfect application of rules for capitalizing the abbreviation of a proper noun, the name of a people, and the pronoun I.
7. At the sixth grade level, children completely erred with respect to certain uses of the comma, the exclamation point, and the hyphen.
8. Consistent erroneous usage traceable to the run-on sentence suggests that more attention could be given to the development of crisp and relatively short sentences throughout the intermediate grades.
9. Errors made with reference to punctuation and capitalization content already covered suggest a need for both the teacher to proofread with care in order to identify errors and to help children proofread so that they can eliminate needless errors.
10. Either greater emphasis needs be placed on little-used items of punctuation (e.g., the dash and parentheses) in order to familiarize intermediate grade children with such items, or these little-used items should be eliminated from the curriculum until after the sixth grade.
11. Teachers could well recognize the need for personalized standards in evaluating and judging work which is unique to individual children.

Microfilm \$3.75; Xerox \$12.80. 292 pages.

#### AN ANALYSIS OF THEORIES OF RECREATION

(L. C. Card No. Mic 59-729)

Jay Sanford Shivers, Ph.D.  
The University of Wisconsin, 1958

Supervisor: Associate Professor H. Clifton Hutchins

The purpose of this study has been to analyze various aspects of theories of recreation that would aid in defining



the nature and essence of recreation, and, on the basis of educational and professional interest, to establish the foundations of a philosophy of recreation.

The method of research was that of a normative critical analysis based on historical and contemporary data. On these data an original thesis as to the definitive structure of recreation and as to the logical organization or disciplining of its thoughts and associated components has been developed.

This presentation has been not merely a summarization or accounting of the many play and recreation definitions and theories, nor has there been an attempt at negative analysis of such theories. Rather it has been designed to promote a clearer concept of the word 'recreation' and to integrate a positive selection of ideas in this particular area of thought that may be systematized into a philosophy of recreation. It is concerned with what recreation is rather than how it is accomplished.

Historically, recreation has come to mean those activities performed in leisure, time that is not spent in meaningful ways for vocation, education or life-sustaining pursuits. Just as history has attached the idea of a specific activity to recreation, so too has custom identified certain specified activities for assumption by the recreation profession. During the course of its existence as a field of social service, the profession of recreation has assumed responsibility for certain forms of activity carried on in leisure, and thereby termed recreational. Through history and habit, recreation has come to be defined in such a restricted sense that its justification for being is largely negated. This thesis has attempted to broaden and give depth of meaning to recreation.

The establishment of a discipline for the field depends upon its relationship to concepts that are traceable to early Greek philosophic views, Renaissance explorations, Enlightenment humanism, and contemporary philosophies of the American culture. With these ideas upon which to build, a discipline of learning set in the framework of rational value judgments that have reference to ethics in human development and behavior has been stated.

Recreation is defined in terms of human behavior. It is any consummatory experience, non-debilitating in character, leading in clear-cut thought or action. As a human experience it has thus been broadened from restrictive definitions to include potentially all human activities. Seen in this light the implications for education, both professional and lay, are tremendously enlarged. At a time when recreation curriculum in institutions of higher education are preparing future leaders and teachers in this field, a single, meaningful statement of the conceptualization of recreation and its place in the American culture needs to be heard. Microfilm \$3.15; Xerox \$10.80. 243 pages.

#### THE SPECIFIC READING PROFICIENCIES OF PUPILS HAVING NORMAL AND ACCELERATED READING GROWTH

(L. C. Card No. Mic 59-1308)

Ellsworth Stanley Woestehoff, Ph.D.  
University of Minnesota, 1958

Adviser: Dr. Guy L. Bond

This study is concerned with the comparison of selected reading skills of third and fifth grade pupils of the

same general reading levels. Fifth grade pupils having normal reading growth and third grade pupils having accelerated reading growth are defined as having reading grade level scores of 4.8 to 5.7, inclusive, obtained on a standardized reading test. The specific reading proficiencies under investigation include the following outcome variables:

1. Speed of reading.
2. Reading to retain information.
3. Reading to organize.
4. Reading to evaluate and interpret.
5. Reading to appreciate.
6. Visual word analysis skills.
7. Knowledge of phonetic elements.
8. Map reading.
9. Reading graphs and tables.
10. Knowledge and use of reference materials.

For purposes of the statistical design, the subjects were assigned to five reading grade levels, each encompassing two-tenths of a year in terms of the reading grade level score obtained on the selection criterion. Further classification was made according to grade placement and sex.

This design provides simultaneous testing of these specific hypotheses: There is no significant difference between mean scores obtained on a given test of specific reading proficiency when the subjects are classified according to:

1. grade placement.
2. sex.
3. reading grade level score obtained on the selection criterion.

Also tested are the hypotheses that there are no interactions between:

1. grade placement and reading grade level.
2. grade placement and sex.
3. sex and reading grade level.
4. grade placement, sex and reading grade level.

The statistical tool used to test the basic hypotheses was an unweighted means analysis of variance. Secondary hypotheses concerning significant interactions were tested by means of the Duncan Multiple Range Test and those concerned with the components of variation due to reading grade level by means of the "F" test.

The results indicate that the grade five group was significantly superior to the grade three group for variables 2, 4, 5, 6, 8, 9 and 10. Girls were significantly superior to boys for variables 3, 5, 6, 7 and 10, while boys were superior to girls for variable 8. A significant linear relationship exists between general reading level and specific reading abilities as represented by variables 1, 2, 3, 4, 5, 7 and 10. The relationships between general reading level and map reading and reading graphs and tables are represented by a significant departure from linearity.

Significant interaction between grade placement and sex was noted on variables 5 and 10 and between grade placement and reading grade level for variables 1 and 8.

The general conclusion is that there appears to be little justification for assuming that a given level of general reading ability will be accompanied by an equivalent level of competency in specific comprehension abilities, visual word analysis techniques and work study skills. These findings lend emphasis to the belief that if these pupils showing a high level of general reading ability are to utilize their reading skills to the fullest, they will need specific and continuous direct instruction in the more mature visual analysis techniques, complex comprehension tasks and work study skills. Microfilm \$3.30; Xerox \$11.20. 255 pages.



## ENGINEERING

### ENGINEERING, GENERAL

#### A STUDY OF DECISION OPERATIONS IN DIGITAL COMPUTERS

(L. C. Card No. Mic 59-696)

William Yeaton Stevens, Ph.D.  
Cornell University, 1958

Before any comprehensive methods for formulating the logical organization of digital computers can be developed, a better understanding of the fundamental concepts that determine this organization is required. One aspect of the computer design problem that has received very little attention is the decision-making ability of digital computers. The purpose of this study is to investigate the basic nature of the decision operations used in digital computers and to discuss various means for implementing these operations. A decision operation is defined as a computer operation in which a test is made to distinguish between two or more well-defined conditions, and in which an appropriate distinct action is taken for each condition thus found.

The study is organized in three parts. The first part is devoted to a detailed discussion of the basic concepts involved in a decision operation. This discussion is conducted without concern for the possibility or practicality of actually implementing the operations. In the second part the methods used in computers that have actually been constructed are examined. These methods are analyzed and compared using the concepts developed in the first part. In the final part of the study various possibilities for other kinds of decision operations are explored, and detailed proposals are made for a number of new operations. The use of these operations is demonstrated by several coding examples.

A decision operation consists of two independent parts, a test and the resulting alternate actions. It is shown that any test may be considered as a comparison among a number of pieces of information, and four types of comparisons are distinguished. Nearly any combination of computer operations can be used as alternate actions of the same decision operation, subject to a few simple restrictions. Although other types of decision operations are desirable for reasons of speed and convenience, it is shown that a sufficient operation is a test for negative, with a resulting jump to a new program sequence for one outcome of the test.

Mathematical analysis can be of considerable assistance in computer design, but it is demonstrated that this technique can not produce an optimum computer design for any practical design problem, due to the impossibility of accurately predicting the future values of all factors in the problem.

A method of classifying decision operations on the basis of several nearly independent characteristics is described. The operations of ten leading commercially produced American computers are classified using this method. The

various approaches to basic design problems that have been used in these and other machines are discussed and evaluated.

A number of ideas for new decision operations are suggested. Five of these are developed in some detail. These are (1) a versatile table-look-up operation, (2) a binary table search operation, (3) a method of suppressing program steps as the result of a test, (4) facilities for program debugging, and (5) a method for controlling interconnected computers.

Microfilm \$2.70; Xerox \$9.20. 205 pages.

### ENGINEERING, AGRICULTURAL

#### AN INVESTIGATION OF ELECTRICAL AND ELECTRONIC MEANS OF MEASURING LIQUID FLOW IN MILK LINES

(L. C. Card No. Mic 59-971)

Robert Henry Brown, Ph.D.  
Cornell University, 1958

In the pipeline system of milking the weight of milk given by an individual cow cannot be obtained without employing accessory equipment. These weight records form a vital part of the information on which herd improvement decisions are based. Currently, one milk meter, which operates on mechanical principles, has achieved the approval of and is being used by certain testing agencies and some dairy farmers. Other dairymen are reverting to the milk pail and scales on testing days.

An investigation of the milk weighing problem was conducted with a view toward bringing about a solution based upon electrical and electronic principles. The metering problem involved the determination and totalizing of the weight of a flowing liquid which is under a vacuum, intermittent, turbulent, pulsating, warm, and mixed with various amounts of air therefore having a variable density. These conditions dictate the choice of a quantity-type flowmeter.

Four measuring principles were tested by designing and constructing meters which electronically or electrically sense and record either weight in 1/2-lb batches, weight in semi-continuous flow, volume in 12 cuin batches (.44 lb), or compensated-volume in 16 cuin batches (.60 lb). One volumeter served for testing both the uncompensated and compensated-volumetric principles and two additional meters were built for testing the weight-sensing principles.

A review of existing meters, discussion of possible solutions, and exploratory measurements with individual components of the meters is presented along with the design



procedure, schematic diagrams and suggestions for improving each pilot model.

The meters were tested in the laboratory under simulated milking conditions and by field tests involving 16 cows randomly selected from two herds. In the field tests the batch weigher had an average percent error of 4.6, with a sample standard deviation of 3.99 and a range from 0 to 16%; the average percent error of the continuous weigher was 11.7, with a deviation of 8.47 and a range from 0 to 26%; and the corresponding values for the volumeter-uncompensated and volumeter-compensated were 6.1, 5.39, 0 to 14.9 and 4.1, 2.92, 0 to 10.3% respectively.

It was concluded that none of the meters can be used continuously in their present form but that each of the four principles is sound and merits further development. The volumetric meters offer the most likely economical and practical solution for obtaining dairy herd milk records and development of the continuous-weigher type of flow-meter is suggested both for milk metering and for other applications involving a sanitary mass-flow determination in which a more complex instrument is economical and appropriate. Microfilm \$2.00; Xerox \$5.60. 113 pages.

## ENGINEERING, AERONAUTICAL

### TORSION WITH WARPING RESTRAINT OF THIN-WALLED TUBES

(L. C. Card No. Mic 58-3157)

Madeline Goulard, Ph.D.  
Purdue University, 1958

Major Professor: Hsu Lo

A theoretical analysis of the effect of warping restraint on torsion of thin-walled tubes is presented. The torsional system chosen is a cantilever, monocoque beam, of doubly symmetric cross section, with or without spanwise taper, under an arbitrary torque loading.

An exact solution to the problem can be derived only for particular geometric configurations and torque distributions. Even then, a large amount of computations is necessary.

In order to derive a general equation which can be readily solved, for a beam with arbitrary spanwise taper and under an arbitrary torque distribution, an approximate method, based on Hamilton's principle and an assumed warping distribution, is used.

This general equation is applied, and solutions are obtained, for the twist due to a static torque, for the natural frequencies in torsion, for the divergence speed, and for the dynamic response to a time dependent torque. The effect of warping restraint on the flutter speed is also discussed.

The accuracy of the approximate solution is ascertained by comparing it, for a few simple cases, with the exact solution, and means of refining it are presented.

Microfilm \$2.00; Xerox \$3.60. 63 pages.

### BLUNT BODIES IN HYPERSONIC HELIUM ABOVE MACH NUMBER TWENTY

(L. C. Card No. Mic 59-299)

Robert H. Johnson, Ph.D.  
Rensselaer Polytechnic Institute, 1958

Supervisor: H. T. Nagamatsu

The blunt profile for aerodynamic bodies has reappeared with the advent of very high speed flight. Hypersonic flow problems have been introduced with the emergence of the ballistic and satellite vehicle. The flow fields in air associated with such hypersonic forms are quite complex due to the formation of a highly excited gas about the body resulting from the very high temperatures. An experimental investigation of the blunt body in hypersonic helium flow is presented. The use of helium gas allows the purely aerodynamic aspects of the blunt body problem to be separated from the real gas effects.

The experiments were run in a hypersonic helium tunnel at Mach Number 22 and 28. The model surface pressures and schlieren photographs comprise the data from which studies were made concerning hemisphere and cone-sphere bodies. Families of shapes of these bodies were chosen as typical of the axially symmetric shapes useful for hypersonic profiles.

The shock wave shape variation with body profile has been determined and shows the importance of the body sonic point location in producing the shock layer flow field. The experiments have further shown that the flow field about many compound bodies may be approximated by either the simple sphere flow or flat circular cylinder flow for which some theoretical treatment has been possible.

The pressure distribution on a cone-sphere body has been measured. An approximate theory is presented for computing the pressure distribution on the cone-sphere, once the shock shape has been determined.

The pressure distribution on a full hemisphere also has been measured and compared with the Newtonian approximation. An improved pressure computation is presented for the supersonic segment of the hemisphere surface.

An instability associated with the flow over blunt bodies with cavities in the surfaces has been discovered. A mechanism involving the successive formation and shedding of vortices is presented as an explanation of the experimental results. The effect of cavity shape and size has been investigated by a series of experiments with some cavity contours in both cylindrical and spherical bodies. A theory based on the unstable flow over cavities has been presented to explain the catastrophic pitting observed on the fused surfaces of some iron meteorites.

Microfilm \$2.00; Xerox \$6.00. 125 pages.



## ENGINEERING, CHEMICAL

A STUDY OF LONGITUDINAL BACKMIXING IN  
LIQUID-LIQUID SPRAY TOWERS

(L. C. Card No. Mic 59-292)

Donald R. Brutvan, Ph.D.  
Rensselaer Polytechnic Institute, 1958

Supervisor: Harry H. Steinhauser, Jr.

Past performance in the study of spray-column extraction equipment has resulted in the collection of a great deal of transfer data with little or no correlation of a general nature. The present investigation is an attempt to initiate a continuing study affecting spray-tower operation at Rensselaer Polytechnic Institute. By determining the dependency of recirculation of the continuous phase by the discontinuous phase on variables such as tower diameter, particle diameter, phase flow rates, and intensive characteristics of the systems involved, it is hoped that a method will result whereby the mass of data now in existence can be correlated and used for further understanding of the nature of the equipment under study.

Recirculation of the continuous phase is described by a longitudinal backmixing coefficient,  $B_E$ . This coefficient is defined in terms of a measurable quantity  $\Delta \ln c / \Delta \theta$ , the change in the logarithm of the concentration within the column with time to a step change in concentration in the column proper at time equal to zero.

Parameters investigated involve column diameters of 1, 1-1/2, and 2 inches, discontinuous phase particle sizes of 6, 5, 4, and 3 mm., flow rates of the continuous phase,  $u_f$ , to approximately 50% of the flooding velocity and discontinuous phase flow rates,  $V_H$ , from approximately 10 to 100 ft.<sup>3</sup>/hr.-ft.<sup>2</sup>.

The system employed consisted of water at room temperature for the continuous phase and spherical glass beads simulating liquid drops for the discontinuous phase. The column end sections were designed incorporating recommendations of Bland and Elgin. Analysis of the concentration changes within the column were made with a colorimeter.

The results of this investigation are in the form of a plot of  $f$  versus particle diameter where

$$f = \frac{(\Delta \ln c / \Delta \theta)}{(u_f^{1.6} / V_H^{0.45})}$$

The longitudinal backmixing coefficient,  $B_E$ , was found to be related to the measured quantity  $(\Delta \ln c / \Delta \theta)$  and the continuous phase flow rate,  $u_f$ , by the following relation:

$$B_E = \frac{(0.28)(u_f)^{2.2}}{\left(\frac{\Delta \ln c}{\Delta \theta}\right) (1.58)(u_f)^{0.07}}$$

It was found that the effective longitudinal backmixing coefficient increased with column diameter and discontinuous phase flow rate, and decreased with increasing continuous phase flow rate and discontinuous phase particle size.  
Microfilm \$2.00; Xerox \$4.20. 78 pages.

KINETICS AND MECHANISM OF  
FORMALDEHYDE CANNIZZARO REACTION

(L. C. Card No. Mic 59-493)

Charles Richard Cupit, Ph.D.  
University of Illinois, 1958

The kinetics and mechanism of the Cannizzaro reaction of formaldehyde with hydroxyl ion was investigated in (1) aqueous, (2) dioxane-water, and (3) alcohol-water systems. Rate dependency on solution ionic strength and dielectric was investigated to determine the nature of the molecular species involved in the formation of the activated complex. An ionic mechanism is proposed for the reaction based on a steady-state concentration of formaldehyde and an assumed hydride-ion transfer from doubly-charged methylene-glycol anion to unhydrated formaldehyde.

The derived rate expression,

$$r = \frac{(C_1^-)^2}{(k_2')^{-1} + (k_{-0})^{-1} (C_1^-)}$$

where  $r$  is the rate of decrease of equivalent aldehyde concentration and  $(C_1^-)$  is the singly-charged methylene-glycol anion concentration, is found to describe the experimental data over the temperature range (10 - 60° C) and concentration range (methylene-glycol anion 0.01 to 1.0 molar) employed in the experimental work. Frequency factors and activation energies for the rate constants  $k_2$  and  $k_{-0}$  are reported. The results of the kinetic investigation are compared with those reported by other investigators; their data are re-evaluated and are found to be consistent with the results reported here.

An experimental investigation of the equilibrium state of aqueous formaldehyde was conducted and values of the hydrolysis constant  $K_{h1}$  for methylene glycol are reported. The experimental values of  $K_{h1}$  are compared with those reported by other investigators, and an equation for the temperature dependency of  $K_{h1}$  and  $K_{a1}$  are proposed.

Alcohols are found to influence the rate of the Cannizzaro by (1) providing a medium of lower dielectric, and (2) chemical inhibition resulting from hemiacetal formation with methylene glycol. A quantitative treatment is given, separating the chemical effect from the physical effect. Values of the equilibrium constant  $K_R$  for reaction of alcohols with methylene glycol are determined for four alcohols. The degree of chemical inhibition per mole of added alcohol is found to be in the order glycerol > methanol > ethanol > n-propanol.

Microfilm \$2.00; Xerox \$6.80. 145 pages.

STUDIES OF GAS-SOLID HEAT TRANSFER  
AND GAS-MIXING IN FLUIDIZED BEDS

(L. C. Card No. Mic 59-706)

John Royal Ferron, Ph.D.  
The University of Wisconsin, 1958

Supervisor: Professor Charles C. Watson

Heat transfer between gas and solid was studied in fluidized beds three inches and eight inches in diameter. The



objectives were to study the mechanisms of heat transport and to attempt to clarify some of the conflicting conclusions of previous studies of this problem.

In addition to bed diameter, operating variables were superficial gas velocity (0.08 to 1.94 feet per second) and bed settled height to diameter ratio,  $L/D$  (0.3 to 3.0). Transient heating or transient cooling experiments were used. Fluidizing gas was air at 140-180°F containing 20-60 grains of water per pound of dry air. The solid was a silica-alumina cracking catalyst (60 micron average particle diameter) obtained from a commercial fluid catalytic cracking unit.

Heat balances on the gas stream were corrected for losses to the surroundings and from desorption of moisture from the particles. It was assumed that temperatures registered by thermocouples immersed in the beds could be averaged to give the space-average solid temperature. Results were evaluated in terms of dimensionless temperatures which were defined without assumptions about the overall patterns of gas flow. Heat transfer coefficients used by previous workers may be expressed in terms of the dimensionless temperatures. It was shown from the behavior of the dimensionless temperatures that conflicting conclusions about importance and relative effects of operating variables in previous work resulted from choices of heat transfer coefficients and driving forces based on assumed limiting flow conditions. Variation of gas backmixing with operating conditions affected both coefficients and driving forces. As a result heat transfer was not fully characterized by expressing results in terms of coefficients alone. A heat transfer coefficient,  $U_i$ , based on the difference between inlet gas temperature and space-average solid temperature as the driving force is more sensitive to operating variables than are coefficients previously used. The quantity  $U_i$  increased with increasing superficial gas velocity, decreased with increasing bed height and was generally smaller for data from the 8-inch diameter unit than from those from the 3-inch diameter unit.

An attempt was made to evaluate various internal heat transfer rates in fluidized beds by analyzing simultaneously the results of the heat transfer experiments and those from transient helium tracer experiments. Difficulties in estimating effects of operating variables on the degree of gas backmixing during the tracer experiments prevented the obtaining of quantitative results.

Microfilm \$3.40; Xerox \$11.60. 262 pages.

#### FRACTIONAL DISTILLATION OF HYDROGEN ISOTOPES ON A PILOT PLANT SCALE

(L. C. Card No. Mic 59-826)

Thomas Murray Flynn, Ph.D.  
University of Colorado, 1958

Supervisor: Associate Professor Klaus D. Timmerhaus

A pilot plant designed on the basis of previous experimental data has been constructed and operated to determine the feasibility of separating hydrogen deuteride from hydrogen by fractional distillation.

The column contains 30 plates six inches in diameter, and has a maximum feed rate of 14.2 SCFM, equivalent to

the production of 48 pounds of heavy water for an 8000 hour year. The column was operated with vapor velocities ranging from 0.2 to 2.0 inches per second, and reflux ratios from total to an  $(L/D)$  of 2.0. Over-all plate efficiencies were investigated, and found to vary as a function of vapor velocity from 45 to 55 percent. These values are lower than those found previously in 1-1/2 inch diameter columns employing the same type of plate. They are still higher than values reported for bubble-cap plates.

This study presents some of the unusual features of separating hydrogen isotopes by distillation at -423°F on a semi-industrial scale and discusses several special problems encountered.

Microfilm \$2.00; Xerox \$5.00. 98 pages.

#### RATE OF DISSOLUTION OF CRYSTALS

(L. C. Card No. Mic 58-2302)

Warren Stanley Heath, Ph.D.  
Syracuse University, 1958

Adviser: C. S. Groves, Jr.

There has been a lack of technical information which can be applied to the design of dissolving apparatus. Recently several investigators have attempted to define a suitable mass transfer relationship for this purpose but have used systems which only partially describe their industrial parallels.

This study was made to develop a single mass transfer equation for gravity dissolvers suitable for a wide range of fluid and flow conditions. The problem was experimentally approached through the two limiting situations of transfer from falling particles and packed beds of the solute. Data were taken for sodium chloride in water to determine the equation and for copper sulfate pentahydrate in water to check its general validity. The data covered a range of Reynold's number of from 1.5 to 2000.

The data were correlated by the use of the Chilton and Colburn mass transfer factor,  $J_d = (k/u)Sc^{2/3}$ , in which the  $2/3$  exponent was experimentally verified over a range of Schmidt number of from 250 to 3000. In order to resolve the differences of apparent rate of transfer of the falling particles and packed beds it was assumed that the arrangement of the particles in the packed bed could be described by the use of an average tetrahedron, the dimensions of which can be determined from the particle size and fractional voids. The tetrahedron was selected because a stable configuration can be reached only when each particle is supported by three contact points.

It was concluded that the rate of transfer from falling solid particles to the solvent can be expressed by the equation;  $J_d = 1.0 Re_s^{-0.6} + 0.01$ . The velocity required for the calculation of the Reynold's number is the maximum terminal velocity, the effect of a restraining wall being only to increase the contact time. The rates of solution from packed solute beds can be approximated by the same equation if the following modifying factors are applied:

$$Re_e = \frac{(1/\psi)(.905/(1-\epsilon)^{2/3} - 1)}{1 - 1.108(1-\epsilon)^{2/3}} \cdot Re_s$$



$$J_d' = \frac{1 - 1.108(1-\epsilon)^{2/3}}{\epsilon} \cdot J_d$$

These factors were developed from the consideration of the average tetrahedron. The effective velocities and hydraulic radii used were calculated from the minimum interstitial areas since each particle is subjected to an impingement stream formed in the passage immediately below it.

The use of these factors was validated by their resolution of several sets of literature data for both falling particles and packed beds.

A considerable amount of work was done on the wall effects of the tube on falling velocities of granular and regular particles and on the determination of effective areas of solids through their coefficients of resistance. It was concluded that the particle area effective in mass transfer can be satisfactorily determined by this method. The available literature showing the variation of the coefficient with Reynold's number is inadequate since it does not account for the discontinuity encountered with granular solids. Future work is thus necessary to develop this technique of surface area measurement.

Microfilm \$2.00; Xerox \$6.00. 125 pages.

#### FILM BOILING ON VERTICAL SURFACES

(L. C. Card No. Mic 59-524)

Yih-yun Hsu, Ph.D.

University of Illinois, 1958

Although considerable attention has been given to boiling phenomena, film-type boiling is still poorly understood. Bromley assumed a viscous flow of the vapor film and was able to derive an equation. However, Hsu and Westwater found that their experimental results were usually 100-200% higher than the theoretical values given by Bromley's equation. The discrepancy was proved photographically to be caused by turbulence and wave motion at the liquid-vapor boundary.

A new equation is presented for film boiling at a vertical surface in the absence of forced convection. An approximate model is postulated by making the following critical assumptions:

1. The vapor flow near the low end of the tube is viscous and Bromley's equation will be valid there. The flow will become turbulent when the Reynold's number reaches about 100.

2. In the turbulent flow region, thermal resistance is due entirely to the laminar sub-layer.

A differential equation was reached and solved by the use of reasonable boundary conditions. The final result is a complicated equation containing Nusselt's number, Reynold's number, and two additional unnamed dimensionless groups.

Five liquids, methanol, benzene, carbon tetrachloride, nitrogen, and argon, were boiled at 1 atm. on a vertical steam-heated tube. The heating tubes were the bayonet-type, with 3/8 in., 1/2 in., and 3/4 in. O.D. and with lengths ranging from 2-5/8 in. to 6-1/4 in. The  $\Delta T$  range was 160 F to 800 F. The data fit the proposed equation within about  $\pm 35\%$ . Microfilm \$2.00; Xerox \$7.00. 146 pages.

#### DYNAMICS OF MASS TRANSFER ON A PERFORATED PLATE

(L. C. Card No. Mic 59-301)

Robert B. Miinch, Ph.D.

Rensselaer Polytechnic Institute, 1958

Supervisor: Harry H. Steinhauser, Jr.

Experimental investigations conducted in this thesis with a single perforated plate distillation column six inches in diameter proved that the liquid mixing on the plate was perfect in the absence of mass transfer. Because the mixing was perfect, there was no concentration gradient under these conditions.

Since other investigators had reported overall plate efficiencies exceeding 100%, and since it was known that concentration gradients existed on small diameter plates during distillation, the mixing which existed on these plates was not perfect. Therefore, the rate of mass transfer was sufficiently rapid to modify the concentration in the liquid due to mixing.

A mathematical model was proposed with which it was possible to calculate concentration gradients and the transient response of a distillation plate. From the transfer functions of the differential equations of this model, an electrical analog circuit was proposed which would solve these equations exactly.

From consideration of probable values of liquid and vapor holdups on distillation plates, the effect of the vapor holdup on the response was shown to be negligible. Accordingly, a solution based on this approximation was obtained.

Microfilm \$2.00; Xerox \$6.20. 127 pages.

#### ETHYLATION OF BENZENE. EXTRACTIVE REACTION.

(L. C. Card No. Mic 59-1315)

William H. Penney, Ph.D.

University of Minnesota, 1957

##### Ethylation of Benzene

Kinetic data has been obtained, using vapor-chromatograph and distillation techniques of analyses, on the two phase Friedel - Crafts ethylation of benzene. Ethylene and hydrogen chloride were used as the alkylating agent and anhydrous aluminum chloride as catalyst. Two liquid phases are formed and the system was kept saturated at atmospheric pressure with the ethylene and hydrogen chloride gases. Benzene depletion and the formation of the six ethylated benzenes in the batch reaction at 60°C were followed for aluminum chloride concentrations varying from 1 to 10% by weight. The system was maintained saturated with ethylene and hydrogen chloride and the diffusional resistances to mass transfer were minimized by using high agitation levels so that the chemical reaction rates controlled the rates of product formation.

For  $AlCl_3$  concentrations above 5%, and after an initial reaction period during which it is believed that rates of reaction at the catalyst surface entered, the benzene depletion reaction was found to be first order with respect to



benzene concentration and the benzene disproportionation reaction followed an apparent zero order reaction.

#### Extractive Reaction

A reaction process occurring simultaneously with an extraction by an immiscible phase is referred to herein as extractive reaction. Relations for several reaction types are obtained which quantitatively show how the rate of reaction, volumetric efficiency and reactant conversion can be altered by imposing an extractive phase upon an isothermal single phase reaction system. Material balance, rate equations and design procedures are developed for two-phase liquid-liquid extractive systems in single or multiple stage continuous stirred tank reactor systems. Analytical solutions are obtained for restricted cases of reversible and irreversible first and second order reactions occurring in batch, single and multi-stage continuous flow stirred tank reactors including the effects of recirculated streams. Graphical methods are also developed and illustrated. Microfilm \$2.50; Xerox \$8.80. 192 pages.

#### A FREQUENCY RESPONSE ANALYSIS OF A FLUIDIZED BED

(L. C. Card No. Mic 58-5299)

Richard Constantino Romano, Ph.D.  
University of Delaware, 1958

Fluidized-bed operation of chemical reactors for reactions involving gas-solid contact has become very widespread in recent years. Such operation offers two very important advantages over fixed-bed operation: temperature uniformity of the bed and ease of solids circulation. On the other hand, a serious disadvantage of the fluidized-bed reactor is that it has a lower conversion efficiency than the fixed-bed reactor; that is, in order to obtain a given level of conversion, a larger amount of catalyst is required per unit of feed in the fluidized bed than is needed in the fixed bed. This reduced efficiency is the result of the large amount of gas mixing in the direction of fluidflow in the fluidized bed and of the failure of some of the gas to come into contact with the solid catalyst. This work was undertaken to study this mixing action by measuring the distribution of residence times of the gas "particles" that pass through the bed.

The residence-time distribution functions were calculated from frequency response measurements. The gas stream to the fluidized bed contained a sinusoidally varying concentration of a tracer gas in air, and the response of the bed to this concentration disturbance was measured at the effluent.

The primary variables studied were particle size of the solids, gas velocity, and bed height. The solid particles used were two uniformly sized fractions of spherical glass beads having average diameters of 234 microns and 119 microns, respectively, and a regenerated silica-alumina cracking catalyst having an average diameter of 41 microns. For the 234-micron particles, the superficial gas velocities were 0.375, 0.75, and 1.0 ft./sec. The gas velocities used for the other solid materials were 0.20, 0.375, and 0.55 ft./sec. The height of the settled bed was 12 inches

for all runs involving glass beads, but runs were made with settled bed heights of both 12 and 20 inches of cracking catalyst.

The results of this work show that: (1) beds of relatively large, uniformly sized, glass beads fluidize very poorly, but cracking catalyst which contains a broad distribution of particle sized fluidizes very well, as judged by the proportion of the gas stream which forms "bubbles" instead of being dispersed uniformly through the powdered solid; (2) for those materials which fluidize poorly, the fraction of the gas stream which flows in the by-pass phase increases as the gas velocity increases; (3) there is only a minor effect of gas velocity on the amount of gas mixing in fluidized beds of large, closely sized particles, but for beads of cracking catalyst, the amount of gas mixing decreases as gas velocity increases; (4) there is no effect of bed height on gas mixing in beds that fluidize well.

Various mechanisms of the gas flow through a fluidized bed have been proposed. This work substantiates the one in which the bed is assumed to be composed of two fluid phases, a dense phase which contains gas uniformly dispersed in the solid material and a bubble phase which contains no solid, with mass transfer between them.

Microfilm \$2.00; Xerox \$6.80. 142 pages.

#### THE REDUCTION OF TITANIUM TETRACHLORIDE BY CALCIUM CARBIDE

(L. C. Card No. Mic 59-839)

Jay John Scheldorf, Ph.D.  
University of Colorado, 1958

Supervisor: Professor Paul L. Barrick

One of the more common methods for the production of metallic titanium involves the reduction of titanium tetrachloride. Numerous materials have been used as reducing agents. Sodium and magnesium have been used commercially while such materials as potassium, calcium, aluminum, hydrogen, etc. have been used in laboratory investigations. One powerful reducing agent which appears to have been used very little, if at all, is calcium carbide.

It was the purpose of this investigation to determine if this reduction would occur and if so to determine the most favorable conditions for the reaction.

It was found that this reduction will take place producing various quantities of free titanium lower chlorides of titanium and titanium carbide. In addition to these products free carbon and calcium chloride were always formed.

In as much as this reduction is quite exothermic in nature, the formation and resultant fusion of calcium chloride proved most detrimental to carrying out the reaction. For this reason, it is virtually impossible to carry out the reduction in a fixed bed type of reactor.

The reduction of titanium tetrachloride in the liquid phase was carried out in sealed glass bombs in the temperature range 200 to 400 °C. At lower temperatures the majority of the reacted titanium was present as free titanium. As the temperature increased, overall yields increased but more and more of the titanium was present as lower chlorides. At the higher temperatures traces of titanium carbide became noticeable.



The reduction of titanium tetrachloride was also carried out in the vapor phase in a fluidized bed. Mixtures of helium and titanium tetrachloride at various concentrations were passed through a bed of fluidized calcium carbide at temperatures ranging from 400 to 600 °C. Several attempts to operate this system at 700 °C. proved to be unsatisfactory due to loss of fluidization. It is believed that this effect was due to the fusion of calcium chloride produced. This fusion slowly agglomerated the bed into a solid mass. An increase in the titanium tetrachloride concentration of the feed resulted in an increase in both free titanium and lower chlorides. A further increase in concentration caused the free titanium to drop off rapidly while the lower chlorides showed a corresponding increase. Again, higher temperatures favored titanium carbide formation.

The production of unexpectedly large amounts of lower titanium chlorides were responsible for several mechanism determining runs being made. It was shown that at the very beginning of the reaction the majority of the titanium was present in the free state. As the reaction proceeded, an increasingly larger percentage of the titanium was present as lower chlorides. There are indications that the actual mechanism may be a very complex one and involve interactions between all three chlorides and free titanium. Under the proper conditions the lower chlorides themselves were reduced by calcium carbide to the free metal.

Microfilm \$2.00; Xerox \$4.00. 72 pages.

#### STUDY OF INTRAPARTICLE DIFFUSION EFFECTS IN A GAS PHASE CATALYTIC REACTION

(L. C. Card No. Mic 59-1317)

Robert E. Schilson, Ph.D.  
University of Minnesota, 1958

Adviser: Neal R. Amundson

A theoretical study of heterogeneous gas phase catalysis was made. This was done by deriving the differential equations of conservation of energy and mass for the general case of simultaneous reactions on a spherical catalyst pellet. The system of differential equations was then solved for the special cases of (1) a single reaction and (2) two simultaneous reactions with the following assumptions:

- (1) The mode of mass transfer of molecules within the pores of the catalyst pellet is by Knudsen diffusion.
- (2) The intrinsic chemistry and catalytic activity of the catalyst surface is independent of the pore size or shape.
- (3) The thermal conductivity of the pellet and the heat of reaction are average values.
- (4) The conditions prevailing at the surface of the pellet are essentially those of the main fluid body.

No assumptions were made relative to the nature of the reaction or its kinetics.

##### A Single Reaction

For a reaction involving  $n$  components, a system of  $n + 1$  second order non-linear ordinary differential equations

was obtained. By mathematical manipulation the solution of the problem was reduced to solving a single second order non-linear ordinary differential equation with temperature as the dependent variable and pellet radius as the independent variable.

In the course of this development a "heat generation function",  $q(T)$ , was defined which is a function of temperature, and two methods of solving the resultant differential equation were developed, depending on the nature of  $q(T)$ . In one method,  $q(T)$  was approximated by a single linear function; in the second method,  $q(T)$  was approximated by two linear functions.

A rigorous solution of the problem was obtained in the form of an integral equation expressing temperature as a function of radius.

##### Two Consecutive Reactions

For a system involving  $n$  components,  $n + 1$  second order non-linear ordinary differential equations are obtained. By mathematical manipulation, the solution of the problem was reduced to solving two second order non-linear ordinary differential equations simultaneously. In one of these two equations a "heat generation function",  $q(T, p_i)$ , was defined; in the other equation, a "reaction rate function",  $w(T, p_i)$ , was defined. Linear approximations of  $q(T, p_i)$  and  $w(T, p_i)$  were defined and utilized in solving the problem. The rigorous solution of the problem was obtained as two integral equations. One equation expressed temperature as a function of pellet radius; the other equation expressed the partial pressure,  $p_i$ , as a function of pellet radius.

The results obtained in the two special cases above permit calculation of the catalyst activity, effectiveness factor, and temperature and pressure gradients. Sample problems were worked to illustrate all methods, and comparison was made with the methods developed by earlier researchers in this field.

Microfilm \$2.45; Xerox \$8.60. 188 pages.

#### MATHEMATICAL ANALYSIS OF ION-EXCHANGE KINETICS IN FIXED-BED OPERATIONS

(L. C. Card No. Mic 59-229)

Chi Tien, Ph.D.  
Northwestern University, 1958

Supervisor: G. Thodos

A general study was made for the mathematical analysis of the transient behavior of a fixed bed operation in which a single-solute liquid solution is passed through a fixed bed of ion exchange resins. The reaction is considered to be unidirectional and the rate-controlling mechanism is assumed to be a combination of the resistances offered by the liquid film and solid diffusion into the spherical particles. The resultant equations consist of two partial differential equations, one integral equation and a general equation relating the surface concentrations of the solid particles and liquid solution. This relation is assumed to be the same as the equilibrium relationship of the same system.

Analytical solutions were obtained for the linear system through the use of Laplace transforms. The inversion integral was obtained with the approximate formula



developed by Rosen. The effluent concentration  $C/C_0$  is found to be:

$$\frac{C}{C_0} = -\left(\frac{K_1}{K_2 C_0}\right) + \left(1 + \frac{K_1}{K_2 C_0}\right) \Phi(\gamma X, \sigma\theta, N)$$

$$\text{and } \Phi(\gamma X, \sigma\theta, N) = \frac{\text{Exp}\left[\sigma\theta \frac{\lambda_0^2}{2} - \gamma X T_0(\lambda_0)\right]}{[2\pi\{1 - \gamma X T_2(\lambda_0)\}]^{1/2}}$$

No analytical solution was available for the non-linear system. A numerical technique was applied to develop the corresponding difference equations and enabled the numerical calculation. The developed procedure has been shown to be convergent and stable. Numerical values for chosen cases were computed with the use of a digital computer.

A particular case, the removal of oxalic acid from glycol-water solution by Permutit SKB was studied specifically for the purpose of demonstrating the application of the conclusions obtained. It has been shown that the value of  $C/C_0$  is a function of several dimensionless groups composed of the operating variables as well as the physical properties of the system, which includes the diffusion coefficient of the solute into the resin particles, the liquid-film transfer coefficient as well as the equilibrium relationship of the system. Experiments were carried out to determine these properties and consequently the prediction of the effluent concentration was made. The predicted value of  $C/C_0$  showed a remarkable agreement with the experimental results.

Microfilm \$2.05; Xerox \$7.20. 154 pages.

## ENGINEERING, CIVIL

### DIFFUSION IN A VERTICALLY HOMOGENEOUS TIDAL ESTUARY

(L. C. Card No. Mic 59-211)

Paul Jacques Huiswaard, Ph.D.  
Northwestern University, 1958

Supervisor: Professor R. B. Banks

Diffusion in a vertically mixed tidal estuary is a problem which has not been solved by exact means, due to incomplete understanding of the physical processes and the complexity of the mathematics involved. In this study, exact solutions are given only for some special cases in which the characteristics of flow as well as the diffusion coefficients assume simplified prescribed forms. For the cases which could not be solved mathematically, expressions were proposed based on known solutions of simpler problems.

For a Plane Continuous Source:

$$\frac{C}{C_0} = \frac{1}{2} \operatorname{erfc}\left\{\frac{x + \xi}{2k\sqrt{t}}\right\} \quad (1)$$

For a Plane Instantaneous Source:

$$C = Mt^{-1/2} \exp\left\{-\frac{(x + \xi)^2}{4k^2 t}\right\} \quad (2)$$

where  $C$  is the concentration ( $C_0$  being the reference or maximum concentration) and  $M = \frac{S}{2k\sqrt{\pi}}$ , where  $S$  is the total mass of material released instantaneously;  $x$  is the longitudinal position coordinate and  $t$  is the time coordinate. Values of the introduced functions  $\xi$  and  $k$  can be evaluated numerically from experimental results.

It can be seen that  $x = -\xi$  denotes the position at which  $C = C_0/2$  in Eq. (1) or the peak position in Eq. (2). Experimental evidence indicated that  $\xi$  had properties similar to the ultimately increasing (but, due to tidal action, periodically varying) distance covered by the net flow.

The quantity  $k$  was assumed related to the diffusion coefficient  $K$  by the relation  $k = \sqrt{K}$ . It was shown experimentally that  $k$  was linearly related to a function  $\alpha$ , defined as  $\alpha = \xi + \bar{U}t$ , where  $\bar{U}$  is the mean velocity of flow over one tidal cycle.

With values of  $k$  and  $\xi$  known, calculation of the dispersion pattern in both cases of a continuous and an instantaneous plane source injection appears possible for any reasonable position in the estuary and at any instant of a tidal cycle.

Experimental work was carried out with two tidal estuary models. In the early stage of the work an experiment was made on the Savannah Tidal Estuary Model at the Waterways Experiment Station, Vicksburg, Mississippi, in which one curie of tritium water was injected instantaneously. Later, many continuous injection tests were run at Northwestern University with methylene blue tracer, using a 45 foot rectilinear tidal estuary model.

An extension of this study to large scale models and even prototypes would be desirable. Future work, besides confirmation and extension of the obtained results, should include an investigation of the effect of a density variation in other than longitudinal direction.

Microfilm \$2.00; Xerox \$5.60. 114 pages.

### DESIGN OF UNDERGROUND STRUCTURES TO RESIST NUCLEAR BLAST

(L. C. Card No. Mic 59-543)

Joshua Levering Merritt, Jr., Ph.D.  
University of Illinois, 1958

This project was undertaken with the purpose of evaluating the experimental results from explosion tests involving underground structures. From this evaluation a set of recommendations for the design of underground protective structures was prepared. These recommendations are presented herein. Primarily these recommendations define the structural strength which must be provided in a rectangular structure to resist the forces produced by a surface burst of a nuclear weapon.

A brief discussion of the major parameters which influence the forces acting on a structure is followed by a specification of the peak magnitude and time variation of these forces. Specific details which define the net forces



acting on the elements of the structure are given. Following a discussion of the effects of the size and function of a structure is a specification of the basic properties of reinforced concrete and steel. Two methods for the design of reinforced concrete elements are given, and detailed charts allowing rapid determination of the parameters which define the response of reinforced concrete members are presented. One method of design is based on a modification to the ACI Building Code while the other is developed herein. The details of the latter are included as an appendix to this volume. Finally specific design recommendations are enumerated and two example designs are presented.

Because descriptions of some of the procedures are rather lengthy it is difficult to summarize them all completely in any single section. However, each recommendation has been given a subject heading which is included in the Table of Contents.

Microfilm \$2.00; Xerox \$6.00. 121 pages.

#### DISPERSION IN POROUS MEDIA

(L. C. Card No. Mic 59-218)

Akio Ogata, Ph.D.

Northwestern University, 1958

Supervisor: Robert B. Banks, Ph.D.

The dispersion of soluble matter in a fluid flowing through porous media can be attributed to three principle causes:

- (a) that due to convective mixing,
- (b) that due to mass transfer from the liquid to the solid phase (or adsorption), and
- (c) that due to molecular diffusion.

In the work presented major emphasis has been placed on convective mixing, while cases where adsorption is important have been considered analytically as special cases. Molecular diffusion has been assumed to be negligible throughout this investigation.

An analytical solution for dispersion in the longitudinal direction was obtained by considering the average concentration across a section of the porous media in a one-dimensional model. It was first assumed that the flux through any fixed plane due to the convective mixing was directly proportional to the concentration gradient. Then, on superimposing this to the transfer due to the seepage velocity, it was possible to describe the concentration variation by means of a partial differential equation, the solution of which could be obtained.

The constant of proportionality  $D$  (or the diffusion coefficient) arising from the above assumption was subsequently determined by experimental means. That is, by comparison of the experimental results with the theoretical results, it was possible to determine  $D$  explicitly for the specific media considered. Analysis indicated that  $D$  is directly proportional to the product of the average velocity and the effective grain diameter of the granular media, the constant of proportionality being of the order 0.11 for laminar flow.

On establishing  $D$ , a radial model was considered theo-

retically. An analytical solution was obtained by means of Laplace transformation, however the expression was too complex for computational purposes. Thus, a finite difference approximation method was employed to predict the concentration at some specific distances from the source well. These results, however, were not verified experimentally. Microfilm \$2.00; Xerox \$6.20. 127 pages.

#### A METHOD FOR DETERMINING STRESSES IN CONCRETE REINFORCEMENT DURING LONG-TIME TESTS

(L. C. Card No. Mic 59-837)

George Chadderton Rouse, Ph.D.

University of Colorado, 1958

Supervisor: Professor William H. Thoman

For several decades, attempts have been made by many investigators to obtain stress data experimentally for concrete and steel of reinforced concrete structural members. These stresses have been determined for structures in service as well as for laboratory specimens. It has been concluded from the results of such investigations that concrete stresses obtained from measured data are not reliable because of the inelastic properties of concrete and the local disturbances produced by embedded instruments. On the other hand, steel stresses determined from experimental data are considered quite reliable provided that the instrumentation used is not subjected to appreciable drift.

This thesis describes the development and fabrication of two types of reinforcing gages which were found to be sufficiently stable for long-time laboratory tests. The transmitting elements used in these gages were the bakelite bonded wire strain gage. To prove the reinforcing gages, eighteen instruments were attached by means of threaded connections to both longitudinal and shear steel for three beam specimens. The gages were read during a seven-week period while the beams were being cured and dried. At the end of this period two of the three beams were subjected to sustained loadings for an additional seven weeks during which the gages were read periodically. Following the completion of the long-time test the beam which had not been subjected to sustained loadings was loaded to failure. Readings of the reinforcing gages embedded in this beam were made for twenty load increments while the test was in progress.

The results of these investigations indicated that the reinforcing gages performed satisfactorily for both short- and long-time loadings. Results of the tests also showed that tensile stresses were not developed in a reinforcing bar until concrete cracks formed in the vicinity of the bar. Before concrete cracking, both longitudinal and shear reinforcement was subjected to compressive stresses ranging from 5 to 8 kips per square inch. Plots of analytical and experimental stresses for the longitudinal reinforcement showed close agreement when each analytical curve was displaced so that it had the same initial value as the corresponding experimental curve. Tensile stresses were not developed in shear reinforcement until the stirrups were intersected by diagonal cracks. Diagonal cracking first appeared in the beam which was tested to failure



when the applied load reached one and one-half times the design load.

Included also in this thesis is a discussion pertaining to the development and fabrication of a strain gage channel switching unit. When coupled to a null-balance type strip chart recorder this instrument can be used for automatic recording of stress data.

Microfilm \$2.00; Xerox \$4.80. 94 pages.

#### DISPERSION IN OPEN CHANNEL FLOW

(L. C. Card No. Mic 59-227)

Ivor Edwin Thomas, Ph.D.  
Northwestern University, 1958

Supervisor: Carlos G. Bell, Jr.

On the basis of the Reynolds analogy, an expression for a virtual coefficient of dispersion is derived for the case of flow in an open channel where the velocity is spatially dependent on the depth only. In accordance with this coefficient, mass is dispersed relative to a section moving with the mean speed of the channel flow, and the two dimensional differential equation is thereby reduced to the one-dimensional case. The functional form of the coefficient expression reveals its sensitivity to changes in the velocity profile.

The numerical value for a particular profile is an order of magnitude greater than the corresponding mean value of the momentum diffusion coefficient taken over the flow depth. An experiment in a channel with a width-depth ratio of 6 to 1 indicated that, where both horizontal and vertical velocity gradients exist, the dispersion coefficient is increased by a further order of magnitude.

The effect of the method of injection is considered, and it is shown that after a sufficiently long time the concentration dispersion approaches the pattern produced by a plane source. Using the transformed dispersion equation, expressions are obtained for the concentrations ensuing downstream from an injection made over an arbitrary time period.

A field dispersion experiment was conducted in the Illinois River System with an injection into the Chicago Main Drainage Channel of approximately 2,000 curies of tritium water and 20 curies of Scandium 46. The tritium served to measure the dispersion produced by the fluid mechanics of the flow, and the Scandium was selected as a representative of the chemical elements in Group IIIA of the Periodic Table. The experimental results showed:

- (a) The effectiveness of tritium water as a hydraulic tracer. In the presence of a variety of pollutants, its movements could be accurately measured by the technique of liquid scintillation spectrometry.
- (b) That the maximum mean tritium concentration at a downstream channel section followed, with reasonable agreement, the distance square root law.
- (c) That with the conditions prevailing during the experiment, the Scandium was removed from the flow according to a first order reaction rate of 0.0051 per hour. Microfilm \$2.00; Xerox \$7.20. 151 pages.

#### ONE-DIMENSIONAL COMPRESSION OF PARTIALLY SATURATED SOIL

(L. C. Card No. Mic 59-234)

Yoshiaki Yoshimi, Ph.D.  
Northwestern University, 1958

Adviser: J. O. Osterberg

The object of this investigation is to analyze the mechanical compressive behavior of a horizontal layer of partially saturated, fine-grained soil subjected to a uniformly distributed vertical load. Specifically it is desired to express the amount of compression of the layer as a function of time, stresses, and soil properties.

The equilibrium state of the elements of partially saturated soil (solids, water, and air) is studied from a physical and mechanical point of view. Partially saturated soil is classified into two types on the basis of the characteristics of soil fluids: (a) a nearly saturated soil in which free air forms small bubbles, and (b) a soil in which pore water is discontinuous and carries a sub-atmospheric pressure.

Compression of partially saturated soil is divided into three stages, each of which involves a distinctive mechanism: (a) initial compression due to compression of gas phase, (b) consolidation due to outflow of pore fluids, and (c) creep.

A theoretical solution is obtained for the ratio of initial compression to total compression. The ratio increases with an increase in the stiffness of soil structure, the initial air content, and the pore water tension.

An attempt is made to express the amount of consolidation of partially saturated soil as a function of time, geometry, stresses, and soil properties. The resulting general expression contains two non-linear partial differential equations which are too unwieldy for a general solution. The equations, however, are solved for a few special cases, and the results are discussed.

A brief discussion of rheological properties of partially saturated soil is presented. For a case in which consolidation is negligible compared to the total compression, a simple mechanical analogy is employed to explain the time dependency of initial compression and creep.

A silty clay from Vicksburg, Mississippi, was compacted in rigid rings and subjected to sustained loads to study its moisture movement, air permeability, and time rate of compression. It was observed that the pore water was practically immobile during compression of the soil samples in which the degree of saturation changed from 70 to 97 per cent, and that the time rate of compression was independent of the sample thickness and drainage conditions.

For a nearly saturated soil in which free air forms bubbles smaller than most pore channels, it is concluded that the time rate of consolidation may be approximated by the Terzaghi solution for fully saturated soil. On the other hand for a soil in which pore water is discontinuous and carries a sub-atmospheric pressure, it is indicated that consolidation may be small compared to initial compression and creep, and that the time rate of strain of a soil layer is essentially governed by the rheological mechanism. In such a case the rate of compressive strain of a soil layer is practically independent of the thickness of the layer.

Microfilm \$2.10; Xerox \$7.40. 160 pages.



## ENGINEERING, ELECTRICAL

ANALYSIS OF LINEAR AND NON-LINEAR  
SAMPLED-DATA CONTROL SYSTEMS

(L. C. Card No. Mic 59-194)

Richard Elmer Andeen, Ph.D.  
Northwestern University, 1958

Supervisor: Richard W. Jones

This paper is concerned with three major problems: (1) the analysis of Pulse Duration Sampled-Data (PDSD) systems with linear continuous elements, (2) the analysis of sampled-data systems with non-linear continuous elements, and (3) the analysis of non-autonomous non-linear systems with continuous inputs. Methods are developed for treating these problems based on sampling theory, the z-transform technique, and the phase-plane representation of dynamic systems. In addition the Principle of Equivalent Areas is derived. The Principle of Equivalent Areas states that two input signals to a continuous element are dynamically equivalent if their integrals evaluated over corresponding sampling intervals are equal and the sampling interval is suitably small. The duration of the sampling interval is based on the characteristics of the input, however in practical systems it is also directly related to the dynamic characteristics of the system elements. The maximum value of the sampling interval is bounded by a value equal to one half the shortest period characteristic of the Fourier frequency spectrum of the input. The Principle of Equivalent Areas holds exactly for the special case of a system with a staircase impulsive response, and is approximate for other systems. The approximation can be made as good as desired by making the sampling interval small.

The analysis of PDSD systems with linear continuous elements is based on the principle described above. PDSD signals are converted to equivalent Pulse Amplitude Sampled-Data (PASD) signals which can then be treated by the usual z-transform techniques. When this is done it is discovered that a pulse duration sampler can be represented by an equivalent circuit consisting of an ideal amplitude sampler plus a hold circuit. Experimental confirmation of these results were obtained in the laboratory with open-loop and feedback PDSD systems.

The analysis of PDSD and PASD systems with non-linear continuous elements is accomplished by a graphical method based on the construction of the path of motion of the forced system from the autonomous phase portraits representing its behavior with zero and constant forcing functions. Since this method used the phase-plane representation it is necessarily limited to second order systems. The behavior of open-loop and feedback non-linear systems are worked out as examples. The results obtained for non-linear feedback systems with coulomb friction and PDSD or PASD signals are compared, and it is found that the system based on PDSD is superior with respect to stability and dead-zone characteristics.

Non-autonomous non-linear systems with continuous inputs are studied by means of the graphical method described above when the continuous input is approximated by an equivalent PASD or PDSD input signal constructed according to the Principle of Equivalent Areas. A system whose behavior is governed by Van der Pol's equation is

studied by this method and the results obtained are consistent with those obtained by Andronow and Witt by another method. It is found that systems with linear elements are studied more conveniently when signals are in the PASD form to which the z-transform technique may be applied, and systems with non-linear elements are more conveniently studied when signals are in the PDSD form for which the behavior of the system may be represented in the phase-plane by a maximum of three different phase portraits. The Principle of Equivalent Areas provides the means for transforming signals into the form most suitable for analysis.

Microfilm \$2.00; Xerox \$7.00. 149 pages.

OPTIMIZATION BASED ON AN ERROR CRITERION  
WITH AN ARBITRARY WEIGHTING FUNCTION

(L. C. Card No. Mic 59-198)

Norbert Theodore Bold, Ph.D.  
Northwestern University, 1958

Supervisor: Gordon J. Murphy

The essential feature of this dissertation is the optimization of a given system based on the mean weighted square error criterion. This criterion, which includes an arbitrary weighting function in the time domain, may be used as a basis for improving the performance of a system when the input function is either statistically or transiently defined. With the proper choice of the weighting function, the mean weighted square error criterion can be reduced to several other criteria presently found in the literature.

The main topic of the investigation is the development of an optimum linear system transfer function from both frequency and time domain analysis.\* The development of the physically realizable transfer function, which utilizes the calculus of variations, involves the definition of a correlation function in two-space and its double Fourier transform. The two-space correlation function is defined statistically as the expectation of the product of three random processes at three given instants of time. The ergodic property is used to equate the ensemble averages and the time averages of the product of the three processes. In all cases, it is assumed that the processes are statistically independent.

Some general properties of the two-space correlation function in the time domain are given. In addition, several relationships to one-space correlation functions and their associated power density spectra are developed.

The conditions required for the application of the criterion are developed to insure the validity of the solution. Along with several possible choices of the weighting function, an extension of Parseval's theorem is given to provide a method of evaluation in the complex frequency domain. A method is also developed which, if the proper information is available, permits the determination of the system frequency function without the use of artificial testing functions. The system frequency function can be determined under normal operating conditions by determining certain two-space correlation functions and their Fourier transforms. This method can be easily applied when a



particular correlation function is an impulse at the origin in the two-space.

Microfilm \$2.00; Xerox \$5.40. 107 pages.

\*This term is defined as the combined fields of analysis and synthesis.

#### AZIMUTHAL SLOTS IN A BICONICAL WAVEGUIDE

(L. C. Card No. Mic 59-537)

Tuck Hop Lee, Ph.D.  
University of Illinois, 1958

An expression for the impedance of azimuthal slots cut into the top wall of a biconical waveguide (of a rather restricted design) is obtained. Numerical computations, the greater part of which is done by the ILLIAC (a digital computer), for a particular slot antenna are carried out for illustrative purposes.

The experiments to verify the theory are described and the experimental results are compared with the theoretical results.

Microfilm \$2.00; Xerox \$4.40. 82 pages.

#### A THEORETICAL STUDY OF THE EQUIANGULAR SPIRAL ANTENNA

(L. C. Card No. Mic 59-541)

Plessa Edward Mast, Ph.D.  
University of Illinois, 1958

In the past few years some entirely new broadband antennas have been developed. At the present time it is easy to construct practical antennas which have essentially the same pattern and impedance over a 10 to 1, or larger, frequency range. One group of broadband antennas utilizes the useful property of the equiangular (logarithmic) spiral curve that a scale change and a rotation are equivalent.

In this paper theoretical methods for determining the electric and magnetic fields produced by an equiangular spiral structure are considered. The equiangular spiral structure consists of two thin conducting strips (arms) with edges defined by equiangular spiral curves developed on a cone. The structure is considered infinite in extent with an arbitrary rate of spiral and an arbitrary cone angle. The planar equiangular spiral is included as a special case. To make the problem amenable to analysis it is necessary in some cases to restrict the gaps between the spiral arms to be small.

Expressions for the static (DC) electric fields are derived from separated solutions of Laplace's equation. The static electric fields are shown to be a function of only two variables. The separated solutions are a product of the circular functions, and associated Legendre functions of imaginary degree and real order. An infinite summation of the separated solutions is necessary to meet the required boundary conditions. For a small gap between the spiral arms the coefficients in the summation are expressed independently in a simple mathematical form. For an ar-

bitrary gap the coefficients can not be determined independently, and the solutions are approximated by a finite sum. The least squares criterion is used to obtain the best values of the coefficients, and the coefficients are expressed as the simultaneous solutions of a finite set of linear algebraic equations.

For the electromagnetic problem, separated solutions of the vector Helmholtz equation are obtained in an oblique spiral coordinate system. The separated solutions are similar to those of the spherical coordinate system. They are a product of Bessel functions of complex order, associated Legendre functions of complex degree and real order, and the circular functions. A double summation is required to satisfy the boundary conditions. Expressions for the coefficients in the summation are derived in terms of the tangential electric fields in the gap between the spiral arms.

For the special case of a balanced antenna with narrow gaps between the arms, expressions are derived for the fields produced in the gaps by a source at the origin. These solutions make available a means of calculating the input impedance, the current distribution, and the pattern of an equiangular spiral antenna.

Microfilm \$2.00; Xerox \$3.80. 66 pages.

#### REMOTE CONTROL OF ELECTRICAL DEVICES BY MEANS OF SEQUENTIAL SIGNALS IN MULTI-PHASE TRANSMISSION NETWORKS

(L. C. Card No. Mic 58-5855)

Ibrahim Hussain Rubaii, Ph.D.  
State University of Iowa, 1958

Chairman: Professor Lawrence A. Ware

Signals for remotely controlling electrical devices are generated by means of non-linear elements and coupled sequentially to the multiphase power lines that furnish power to the controlled apparatus.

Control signal frequencies are sequentially coupled onto the three phase power transmission lines such that they form either a positive, negative, zero phase sequence, or any two or more phase sequences combined.

At the controlled apparatus, the signal frequencies are recovered from the background frequencies in two major steps.

First, sequential separation of group of frequencies that belong to either positive phase, negative phase, or zero phase sequence groups; and recovering the groups which include the control signal frequencies.

Second, the control signal frequency or frequencies are then filtered from their sequential groups by means of highly selective devices such as torsion resonators for slow response controls and the negative resistance, Q multiplying circuits for high speed response. The angular displacement from the torsion resonator is made to actuate another electronic circuit by introducing appreciable change in the resistive, capacitive, or inductive parameters of a circuit element.

For close loop automatic operation, the message which is delivered to its final destination is made to actuate another signal generator in order to provide a feed-back



signal of different frequency and of different sequence relationship. The original signal will then serve as an error or forward feed signal.

Appendix A is devoted to an analysis of the transmission of the second and fourth harmonic frequencies along 60 cps power transmission lines. The 60 cps power transmission lines are chosen for analysis and simulation because they are the most commonly used in the residential areas throughout the United States.

Appendix B includes mathematical treatment of conditions of non-linearity under which submultiple, multiple, and ultra-submultiple frequencies can be generated from a fundamental frequency.

In the bibliography a list of books and periodicals covering related topics is presented for the interested reader.

Microfilm \$2.00; Xerox \$6.80. 143 pages.

### A STUDY OF FLICKER NOISE IN MULTI-ELECTRODE VACUUM TUBES

(L. C. Card No. Mic 59-1299)

Robert Charles Schwantes, Ph.D.  
University of Minnesota, 1958

This investigation is primarily concerned with flicker noise in triodes, pentodes, and secondary emission pentodes. The division of noise currents in multi-collector tubes and other noise properties peculiar to such tubes are investigated. In addition, a study of the results leads to some general conclusions about the noise generation mechanism in oxide cathode tubes.

An anomalous flicker noise occurring in some oxide cathode tubes has been investigated using triodes operated with the grid potential in the vicinity of zero volts. The spectrum found is of the form

$$S(\omega) = A + B/\omega + \frac{C\tau^2}{1 + \omega^2\tau^2}$$

where the last term represents the anomalous effect. The dependence on grid voltage and cathode temperature was measured. The effect is attributed to positive ions emitted by the cathode.

The division of noise currents between the electrodes in positive grid triodes was investigated. The ratio of the mean square noise current at the anode to that at the grid was measured and compared to the d.c. current ratio, the signal current ratio, and the ratio of current changes due to a small change in emission current produced by a small cathode temperature change. In addition, the correlation between the grid and anode noise currents was measured and found to be always positive. The results indicate that one or both of the following conditions exist:

- (a) The electrons causing the flicker noise have a lower than average velocity, or
- (b) The cathode areas associated with the flicker noise generation are large compared to the grid wire diameter.

A noise equivalent circuit is developed for a pentode and the various parameters evaluated in some typical tubes. It is found that the noise can be represented with good accuracy by a voltage generator  $e_g$  at the control grid and an independent current generator  $i_p$  between screen and anode. The current  $i_p$  can formally be interpreted as a flicker partition noise.

Measurements were made on a secondary emission pentode using a cathode feedback circuit. These show that a flicker noise exists in the secondary emission process, which contributes to the noise of these tubes.

Microfilm \$2.00; Xerox \$4.40. 84 pages.

### IMPEDANCE AND NOISE MEASUREMENTS OF VARIOUS GAS DISCHARGE DEVICES

(L. C. Card No. Mic 59-1301)

Katsunori Shimada, Ph.D.  
University of Minnesota, 1958

The impedance and the noise measurements were taken in the frequency range between 1 mc/sec and 30 mc/sec by comparing the gas discharge tube with a known impedance and the saturated diode type 5722 as a standard noise source. The measurements were taken on commercial neon or argon lamps, lab-built tubes with probes and a movable-anode tube, for various modes of coupling to the gas discharge.

The noise temperature obtained from the noise ratio was compared with the electron temperature determined from the probe characteristics.

The efforts to locate impedances in the gas discharge i.e. in the cathode fall region, the plasma, the anode fall region and in the ion sheath were only successful within a very limited scope because of the fact that the effect of one impedance is masked by the other or that one part of the tube is coupled to the other which makes separation difficult.

Nevertheless, the following conclusions were obtained:

- 1) The noise generated in gas discharge tubes can be divided into two parts, the cathode noise and the plasma noise.
- 2) The noise temperature of the cathode noise, which usually is a function of the discharge current, has a frequency spectrum of almost  $1/f$  and is much larger than the plasma noise temperature at lower frequencies. Cathode noise becomes negligible in comparison with plasma noise at sufficiently high frequencies.
- 3) The plasma noise temperature has a flat frequency spectrum and is most likely equal to the electron temperature.
- 4) The noise obtainable through wrapped-around probes or probes immersed into the plasma is influenced by the noise generated in the ion sheath under the probe. The noise temperature of the probe impedance for a floating probe ( $I_{pr} = 0$ ) is equal to the electron temperature. Probes immersed into the plasma give shot noise in addition to the thermal noise of the ion sheath and the plasma when probe current is drawn.
- 5) The noise temperature at high frequencies (larger than 30 mc/sec) is independent of the mode of coupling to the tube and nearly equal to the electron temperature, indicating that indeed the plasma noise predominates at high frequencies.
- 6) Gas discharge tubes can be used as reliable noise sources down to a few mc/sec; the recommended circuit arrangement is that of a single wrapped-around probe as output electrode with anode and cathode grounded. In this arrangement the cathode noise has very little influence upon the noise output power.



7) The arrangement of the single wrapped-around probe mentioned under (6) is a convenient way of determining the noise temperature of the plasma since this noise temperature is frequency independent. This might be used for a very simple determination of the noise temperature of microwave gas discharge tubes.

8) Noise temperature measurements might be a very convenient means of determining the electron temperature of the high-current discharges used in nuclear fusion research.

9) There are some vague indications that some of the impedances observed in gas discharge tubes at high frequencies might have to be described by a distributed parameter network. More work is needed to establish this beyond doubt. Microfilm \$2.00; Xerox \$4.80. 92 pages.

## ENGINEERING, MECHANICAL

### OPTIMIZATION OF SERVOMECHANISMS HAVING VELOCITY SATURATION

(L. C. Card No. Mic 59-1280)

Socker Lee, Ph.D.  
University of Minnesota, 1958

Adviser: K. Cegate

In this thesis, a switching criterion and switching equations of an optimum on-off third order feedback control system having the characteristics of velocity saturation are investigated.

Preliminary discussions are made for the analyses of switching criteria and switching equations of optimum on-off third and higher order feedback control systems.

Applying the theory of the convolution in the Laplace Transform, the proof of the uniqueness of switching times and the proof of minimum response time in optimum on-off control systems are presented. A method for finding switching times by the convolution integral is proposed. Also discussions are made for the analysis of switching criteria proposed by a few authors.

A method for obtaining switching equations in optimum on-off third and higher order control systems subjected to positional step input is proposed. This method eventually leads to a transformation of the coordinates of the phase space built for the analysis of the system.

The switching equations for the critical surface of the general type of third order control system are derived, and the trajectory equations projected on the phase planes are investigated considering the effects of velocity saturation.

One of the most important results of the investigation is that, if the amount of a step input is larger than a certain value, there is a unique trajectory along which system response takes place, and the equation of such a trajectory is the same equation as treated in the case of the second order control systems; thus the complicated switching equations of the third order system are simplified when velocity saturation is considered. As a result, the dual-mode operation is proposed for practical purposes.

At the end of the thesis, it is shown that the results of

the experimental analysis agree with those of the theoretical consideration given for the third order control system having velocity saturation.

Microfilm \$2.00; Xerox \$6.00. 124 pages.

### AN ANALYTICAL AND EXPERIMENTAL INVESTIGATION OF TURBULENT FLAME PROPAGATION UTILIZING A TURBULENT FLAT FLAME BURNER

(L. C. Card No. Mic 59-224)

William Thomas Snyder, Ph.D.  
Northwestern University, 1958

Supervisor: Ali Bulent Cambel

In this dissertation, the problem of turbulent flame propagation is investigated analytically and experimentally. The analytical formulation of the problem is based upon a one dimensional model. The conservation of mass, momentum, and energy are expressed in the appropriate mathematical form. The conservation of mass equation is written on a chemical specie basis and is supplemented by classical reaction kinetics for evaluating the rate of production of chemical species. By introducing certain simplifying assumptions, the conservation equations are solved for the turbulent flame propagation velocity. It is shown that the influence of the turbulence intensity on flame propagation velocity can be expressed in terms of a semi-empirical turbulent exchange coefficient. The theoretical dependence of the turbulent flame propagation velocity on turbulence intensity agrees qualitatively with the experimental trends observed both in this study and by other investigators. In the experimental phase of this investigation, a new technique for obtaining turbulent flame propagation data is demonstrated. This technique is based on a modification of the flat flame burner which has been used in the study of low velocity laminar flames. The experimental data obtained with the one dimensional flame burner agree qualitatively with the theoretical predictions set forth previously.

Microfilm \$2.00; Xerox \$5.60. 112 pages.

## ENGINEERING MECHANICS

### WAVE TRANSMISSION IN CHAINS OF OSCILLATORS AND CONTINUOUS STRUCTURAL ELEMENTS

(L. C. Card No. Mic 59-255)

Jerald Nelson Christiansen, Ph.D.  
Stanford University, 1958

This dissertation includes the study of discrete systems composed of springs and rigid masses and also certain continuous flexible elements.

In each case, the basic objective was to determine for which range of frequencies, if any, a sinusoidal disturbance



would be propagated through the system without attenuation, then to find the relation of wavelength to frequency, and other aspects of the response.

In some instances the propagation of transients was studied. In particular, the method used and the solutions found for transients in the chain of oscillators are believed to be new. The method is applicable to problems which involve the solution of an equation which is a difference equation with respect to one variable, and is a differential equation with respect to a second variable. For example the equation

$$\ddot{x}_n(t) - p^2 \Delta^2 x_{n-1}(t) = 0 \quad (1)$$

can be solved by using the function

$$F(\zeta, t) = \sum_{-\infty}^{\infty} x_n(t) e^{in\zeta} \quad (2)$$

and the Fourier coefficient formula

$$x_n(t) = \frac{1}{2\pi} \int_c^{c+2\pi} F(\zeta, t) e^{-in\zeta} d\zeta \quad (3)$$

Substituting (3) in (1) yields the differential equation

$$\ddot{F} + 4p^2 \sin^2 \frac{\zeta}{2} F = 0 \quad (4)$$

which has the solution

$$F = A \sin(2pt \sin \frac{\zeta}{2}) + B \cos(2pt \sin \frac{\zeta}{2}) \quad (5)$$

Equation (2), evaluated at  $t = 0$ , provides the value of  $B$  and, when differentiated before setting  $t = 0$ , it yields the value of  $A$ . Substituting everything back in (3) then gives the final solution

$$x_n(t) = \sum_{-\infty}^{\infty} x_s(0) \Phi_{n-s}(t) + \sum_{-\infty}^{\infty} \dot{x}_s(0) \Psi_{n-s}(t) \quad (6)$$

where

$$\Phi_{n-s}(t) = \frac{1}{2\pi} \int_c^{c+2\pi} \cos(n-s)\zeta \cos(2pt \sin \frac{\zeta}{2}) d\zeta \quad (7)$$

and

$$\Psi_{n-s}(t) = \int_0^t \Phi_{n-s}(\tau) d\tau \quad (8)$$

These integrals can be evaluated in terms of Bessel Functions if desired.

The response of the discrete system, to an arbitrary force applied at one of the masses, was obtained by use of a Duhamel integration.

Microfilm \$2.00; Xerox \$6.20. 126 pages.

## ELASTIC PLATES WITH CIRCULAR INSERTS SUBJECTED TO CONCENTRATED FORCES

(L. C. Card No. Mic 59-205)

John Dundurs, Ph.D.  
Northwestern University, 1958

Supervisor: Professor M. Hetényi

The problem treated is that of a plate of unlimited extent containing a circular insert and subjected to a concentrated radial force in the plane of the plate. The elastic properties of the insert are different from those of the plate, and a perfect bond is assumed between the two materials.

The solution is obtained by assuming the general forms of the Airy stress functions for the plate and the insert, while preserving sufficient freedom in terms of indeterminate coefficients to satisfy the boundary conditions. Complex variables are used in the analysis solely for manipulative convenience.

The solution is exact within the classical theory of elasticity, and is obtained in a closed form in terms of elementary functions. Explicit formulae are given for the components of stress in Cartesian coordinates, and also in polar coordinates at the circumference of the insert. The solution for an empty hole in the plate, and that for a rigid insert, are two limiting cases of the general solution.

To show the effect produced by different ratios of the shear moduli, the stresses are evaluated and represented graphically for various ratios of these moduli, while the concentrated force is applied at a distance of two radii from the center of the insert.

Microfilm \$2.00; Xerox \$4.60. 87 pages.

## STRESSES IN AN ELLIPSOIDAL ROTOR INDUCED BY A CENTRIFUGAL FORCE FIELD

(L. C. Card No. Mic 59-307)

Martin A. Goldberg, Ph.D.  
Rensselaer Polytechnic Institute, 1958

Supervisor: Michael Sadowsky

This paper contains an exact solution for the stress distribution in a solid triaxial ellipsoid, rotating about the  $z$  axis with constant angular velocity. The surface of the body is free from boundary stresses. The solution covers as limiting cases the known results for rotationally symmetric solids and the elliptic cylinder.

Included also is an exact three-dimensional solution of a rotating spheroid whose field equations are those of plane stress. This yields the exact solution for rotating disks cut from the spheroid by any two planes perpendicular to the axis of rotation.

The ensuing stress equations are obtained in terms of nine coefficients of superposition. These coefficients have been evaluated for various shape ratios and are presented in tabular form.

The technically important aspects of some numerical examples are discussed in detail.

Microfilm \$2.00; Xerox \$3.80. 66 pages.



# UNIFORMLY STRETCHED PLATES LOADED BY CONCENTRATED TRANSVERSE FORCES

(L. C. Card No. Mic 59-212)

Arnold D. Kerr, Ph.D.  
Northwestern University, 1958

Supervisor: M. Hetényi

The object of this dissertation was to study the behavior of plates of various shapes subjected to uniform tension in the plane of the plate and loaded transversely by concentrated forces.

The deflection,  $w$ , of the plate is governed by the partial differential equation

$$\Delta \Delta w - \kappa^2 \Delta w = 0$$

where  $\kappa^2 = \frac{N}{D}$ .  $N$  is the tension intensity per unit length and  $D$  is the flexural rigidity of the plate.

The fundamental deflection function due to a concentrated force,  $P$ , at  $r = 0$ , was defined as the solution of the above equation for the axially symmetrical case. It was found to be

$$w = -\frac{P}{2\pi N} [\ln r + K_0(\kappa r)],$$

where  $K_0(\kappa r)$  is the modified Bessel function of the second kind. The fundamental deflection contains the singular term

$$\frac{P}{8\pi D} r^2 \ln r \text{ and is equal to zero at } r \rightarrow \infty.$$

This fundamental deflection function was used in connection with the method of images to construct solutions for plates of various shapes, simply supported along their boundaries.

Solutions for the following cases were obtained:

- Wedge-shaped plate with opening angle  $\alpha = \frac{\pi}{m}$ , ( $m = 1, 2, \dots$ )
- Infinite strip.
- Semi-infinite strip.
- Rectangular plate.

The expressions for deflections, reaction distribution, and for the corner reaction of the rectangular corner plate ( $\alpha = \frac{\pi}{2}$ ), as well as the reaction distribution of the infinite

strip, were evaluated numerically for different  $\frac{N}{D}$  ratios to show the influence of this ratio on the calculated quantities.

Microfilm \$2.00; Xerox \$3.00. 53 pages.

# CIRCULAR CYLINDERS OF FINITE LENGTH SUBJECTED TO ARBITRARY SURFACE TRACTION

(L. C. Card No. Mic 59-214)

David Warren Lewis, Ph.D.  
Northwestern University, 1958

Supervisor: Professor Miklos Hetényi

This work presents solutions to solid and hollow circular cylinders of finite length which are subjected to quite arbitrary axially symmetric surface tractions. From a number of functions which satisfy the biharmonic equation are constructed "stress functions" capable of satisfying certain boundary conditions. All of the solutions have the limitation that the stresses on the curved surfaces are symmetrical with respect to the central circular section of the cylinder.

The solution to the solid cylinder satisfies the conditions of zero shearing stress on all of the bounding surfaces, arbitrary normal stresses on the curved surface, and arbitrary normal stress on the plane ends. By "arbitrary" is implied those functions which are describable by Fourier and Fourier-Bessel series. The stress function (in terms of the radial and axial coordinates,  $r$  and  $z$  respectively) is:

$$\begin{aligned} \phi = & A_0 \left[ z^3 + \frac{3\mu}{1-2\mu} r^2 z \right] + B_0 \frac{z \log r}{2} \\ & + \sum_{m=1}^{\infty} A_m J_0(\alpha_m r) \left[ z \cosh \alpha_m z - \frac{(2\mu \sinh \alpha_m z + \alpha_m z \cosh \alpha_m z)}{\alpha_m \sinh \alpha_m z} \sinh \alpha_m z \right] \\ & + \sum_{n=1}^{\infty} B_n \sin \beta_n z \left[ r I_1(\beta_n r) - \left( \frac{2(1-\mu) I_1(\beta_n a)}{\beta_n I_1(\beta_n a)} + \frac{\beta_n a I_0(\beta_n a)}{\beta_n I_1(\beta_n a)} \right) I_0(\beta_n r) \right] \end{aligned}$$

The first solution to the hollow cylinder permits the choice of arbitrary normal stresses on the inner and outer curved surfaces. The shearing stresses are required to be equal to zero on all of the bounding surfaces. The normal stress over the plane ends cannot be controlled in form, however, the average value can be specified. A stress function capable of meeting these conditions is:

$$\phi = A_0 r^2 z + B_0 z \log r + \sum_{n=1}^{\infty} \left[ A_n r I_1(\beta_n r) + B_n I_0(\beta_n r) + C_n r K_1(\beta_n r) + D_n K_0(\beta_n r) \right] \sin \beta_n z$$

The second solution to the hollow cylinder is much more general. Only the shearing stress over the plane ends cannot be of arbitrary form as it is maintained equal to zero. All of the other stresses may be specified arbitrarily subject to the limitations above, i.e., axially symmetric and symmetric with respect to the central section of the cylinder. For satisfying these boundary conditions, the following stress function is used:

$$\begin{aligned} \phi = & \sum_{n=1}^{\infty} \left[ A_n r I_1(\beta_n r) + B_n I_0(\beta_n r) + C_n r K_1(\beta_n r) + D_n K_0(\beta_n r) \right] \sin \beta_n z \\ & + \sum_{m=1}^{\infty} E_m J_0(\alpha_m r) \left[ z \cosh \alpha_m z - \frac{(2\mu \sinh \alpha_m z + \alpha_m z \cosh \alpha_m z)}{\alpha_m \sinh \alpha_m z} \sinh \alpha_m z \right] \\ & + G_1 z \log r + G_2 z^3 + G_3 r^2 z \end{aligned}$$



Numerical work has been limited to the first solution of the hollow cylinder. A cylinder is subjected to a band of constant tension over the middle one-fifth of the inner surface. The solution is essentially a Fourier series and the results indicate the effect of the number of terms used in the series (10, 15, and 30 terms). All of the stresses and the radial displacement are presented graphically and as tabulated data for two different wall thicknesses. The approximate results according to Lamé and according to the "beams on an elastic foundation" theory are compared with the results of this work.

The solution of the solid cylinder and the second solution of the hollow cylinder each consist of both Fourier and Fourier-Bessel series. The coefficients of each of these two types of series depend upon the coefficients of the other. Iterative methods are outlined for the solution of the interdependent sets of simultaneous algebraic equations.

For all but the most unusual types of loadings, many terms in the solutions are required to obtain a high degree of accuracy in describing the loading. Considering the nature of the solutions, it is highly desirable to perform numerical calculations by some type of automatic digital computer. This is particularly true of those requiring an iteration process for the solution.

Microfilm \$2.00; Xerox \$3.60. 65 pages.

#### PLASTIC BUCKLING OF SIMPLY SUPPORTED PLATES WITH LONGITUDINAL STIFFENERS SUBJECTED TO UNIFORM COMPRESSION

(L. C. Card No. Mic 59-697)

Henry Leo Sujata, Ph.D.  
Cornell University, 1958

Formulae are developed which define the plastic buckling coefficients for a simply supported plate stiffened by longitudinal stiffeners and subject to uniform compression in the direction of the stiffeners. The equations are developed by consideration of the strain energy of plastic buckling. The cases considered in detail are the plate stiffened by one, two and an infinite number of stiffeners. Design charts are presented which give the buckling coefficients for infinitely long stiffened plates. A method is presented by which approximate buckling coefficients for any aspect ratio may be evaluated.

The effective width of the plate which can be attributed to the stiffener is analysed by a method which takes into account the plate anisotropy in the plastic range. The case of a sheet with one stiffener connected to web plates as well as the case of a plate with an infinite number of stiffeners are considered analytically. The results show that the effective width varies with the degree of plasticity and the state of stress. Further, it is shown that the difference in the effective width between the elastic and plastic cases can be significant, and its proper evaluation may be of economic importance. Recommendations are made for determining the effective width when the plate possesses an arbitrary number of stiffeners.

An example problem is presented which demonstrates the use of the charts and a design procedure.

Microfilm \$2.00; Xerox \$5.80. 118 pages.

#### ENGINEERING, METALLURGY

##### SELF-DIFFUSION IN SILVER DURING PLASTIC DEFORMATION

(L. C. Card No. Mic 59-495)

Joseph Branch Darby, Jr., Ph.D.  
University of Illinois, 1958

Self-diffusion of  $\text{Ag}^{110}$  in silver single crystals subjected to simultaneous deformation at 800 and 900°C was studied using the sectioning technique. The crystals were orientated for duplex slip and were deformed in extension and compression at constant strain rates in the range 1 to  $28 \times 10^{-5} \text{ sec}^{-1}$ . Total strains as large as 0.33 were attained. Recrystallization occurred in the initially single crystal specimens during diffusion-deformation under all conditions except tension at 800°C.

The effect of straining on the rate of diffusion was found to be small in all cases. The straining changed the diffusivities by less than 50 percent, and it is concluded that the observed changes were probably within the experimental error. The results indicate that any increases in diffusion rate due to the generation of point defects or shortcircuiting paths during deformation were small. These conclusions are shown to be consistent with current ideas concerning these phenomena.

Microfilm \$2.00; Xerox \$3.00. 45 pages.

##### THE REDUCTION OF HEMATITE TO MAGNETITE BY CARBON MONOXIDE

(L. C. Card No. Mic 59-1268)

John Paul Hansen, Ph.D.  
University of Minnesota, 1958

Pellets of hematite prepared from Baker's Ferric Oxide and fired at temperatures of 1250°C, 1325°C, and 1375°C were reduced to magnetite using a mixture of carbon monoxide, carbon dioxide, and nitrogen. Using a loss of weight method, reaction rates were measured and correlated with the composition of the gas mixture, temperature of reduction, and variation in the rate of gas flow.

Initially, the gas phase in equilibrium with a hematite-magnetite mixture was analyzed to determine its equilibrium composition as the temperature varied from 778°K to 1223°K. The experimental results were consistent with published data.

As reduction progresses, the area of the hematite-magnetite interface decreases. Reaction rates during the course of reduction corresponded with those which would be predicted if the rate were assumed to be proportional to the interfacial area. This indicates that the interface advances at a constant rate depending upon the temperature, the composition of the gas phase, and other variables.

The rate of advance of the interface was determined as a function of temperature. By plotting the log of the rate against  $1/T$  the activation energy of the rate controlling steps was measured.

The rate of advance of the interface was also determined as a function of the composition of the gas phase.



Rate controlling steps were hypothesized from their dependence on the gas composition and their activation energy.

The autocatalytic nature of the reduction of hematite to magnetite was verified with induction times varying up to 125 minutes. Comparison of these results to the Volmer-Weber-Becker-Doring Theory of phase transformation gave an activation energy for nucleation of 16,400 cal/mole. From the effect of the gas composition on the induction time the size of the critical nucleus was approximated.

When the temperature of reduction was increased above 500°C, the rate passed through a minimum at temperatures of between 600°C and 700°C and then increased rapidly with temperature. This same phenomenon has been observed in the complete reduction of iron ores, and has usually been attributed to the formation of a wustite or iron layer, which impedes further reaction. Because neither of these phases were present in this study another explanation is offered to account for this phenomenon.

Microfilm \$2.00; Xerox \$6.40. 132 pages.

#### A STUDY OF SOME FUNDAMENTALS IN THE DIP BRAZING OF 3S-ALUMINUM ALLOY

(L. C. Card No. Mic 59-300)

John J. McCarthy, Ph.D.  
Rensselaer Polytechnic Institute, 1958

Supervisor: Ernest F. Nippes

In this work a brazing technique was conceived for brazing of 3S-aluminum alloy which consisted of complete immersion of bare 3S-alloy material into a molten brazing alloy and effecting bonding in this manner.

The dip brazing investigation involved two distinct problems. The first consideration was the satisfactory removal of aluminum oxide from the sheet surface prior to brazing. The second was the actual brazing operation and was the major problem with a considerable number of variables to be studied.

Previous studies rendered valuable data for the surface

cleaning investigation. Hydrofluosilicic acid was used as the cleaning agent for the 3S-alloy sheet. Several acid concentrations were used and optimum cleaning times determined.

In the brazing phase of the investigation the more important variables considered were: (1) a suitable molten brazing alloy to effect complete wetting of the 3S-alloy sheet (2) preheat and preheat temperature of the sample to be brazed and (3) a satisfactory brazing atmosphere.

Edge melting and time for alloying data were used to study the numerous brazing variables. Time for alloying may be defined as the minimum time at a given temperature to completely wet the aluminum alloy sheet surface and edge melting as the maximum time at a given temperature before edge melting of the 3S-alloy sheet surface took place.

A preheat temperature equal to or not more than 30°F above the brazing temperature was found desirable. Argon was found to be the most satisfactory brazing atmosphere.

A series of binary and ternary alloys were studied in an attempt to determine the critical temperature for brazing.

The binary alloy study revealed that time between sheet wetting and edge melting was at a minimum when the brazing temperature was less than 75°F below the solidus of the 3S-alloy sheet. It was further shown that a maximum "working time range" did not exist unless brazing was accomplished at temperatures not to exceed 25°F above the liquidus of the brazing alloy.

Study of liquidus of the molten brazing alloy was the main criterion for satisfactory brazing until the temperature below the 3S-alloy solidus was exceeded by 150°F. Then it appeared that brazing temperature itself was the main variable of consideration.

The possible use of deoxidants was studied in some detail. This survey was deemed necessary in order to minimize the time for complete sheet wetting. Magnesium was found to be the most desirable oxide removing agent.

Because it is well known that crucibles for containing aluminum alloys presents a serious problem this variable was studied in some detail. Clay-graphite was found to be the most desirable from the viewpoint of melt cleanliness and thermal shock.

Microfilm \$2.00; Xerox \$5.60. 113 pages.

#### FINE ARTS

#### THE SOCIOLOGY OF ART IN AMERICA

(L. C. Card No. Mic 58-5110)

Philip Mark Allen, Ph.D.  
Emory University, 1957

Although American sociology has by now become a considerable scientific discipline, substantial in its achievements and growing in prestige, the sociology of music, art and literature has been virtually ignored in this country. A few American sociologists have taken definite steps to establish and advance this branch of social science, and

others have made incidental or tangential contributions to its maintenance, but, in the main, art as a sociological subject has been sorely neglected. Whatever the reasons behind this paucity of attention, the institutional character of art as a phenomenon of history and a province of social action definitely justifies consideration of the arts from a sociological point of view.

Art as an institution is merely the expression which characterizes actions having to do with art in terms of a conception of the social structure. These actions, considered as sociologically relevant, are transacted according to customary forms derived from the individual's social



identity, i. e., his mode of access to the materials and functions of the institution art.

The institution art, through the relative authority of its peculiar customs, group constitutions and the consequences of transactions, participates in an interactive relationship on a part with its environment of social institutions -- with religion, income, family, law, education and the like. It is the relations of social identity to transactions and aesthetic transactions to social action in general that the sociology of art seeks to understand.

The arts, like the markets, the laws and the ethical prescriptions of a society, pose problems which can be approached sociologically from a number of standpoints. These approaches vary in depth from behavioristic or naturalistic description of transactions to symbolic interpretation and "imputation." Description becomes imputation when a particular art work, art form or transaction is provided with a specific position in a systematic conception of the social structure.

Imputation can occur on any of four distinct levels of concern for symbols: (1) naturalistic imputation, (2) historical imputation, (3) ideological imputation, and (4) functional imputation. Each imputative level expresses a different way of perceiving art's social relationships. Each of the four approaches has its examples, and each has its own pertinent methods of research. The fourth level of imputation, however, attempts most fully to comprehend the character of art works as symbols of social activity, as integral parts of a chain of relationships, associated by transactions with other institutions.

The achievements of the sociology of art in America to date have been thinly spread over a number of subjects -- sub-institutions in the institution art. The visual arts have been left virtually untouched by American sociology, but some study, in the main stream and the tributaries of the discipline, has been devoted to determining the social relationships of music, literature, the radio drama and the motion picture in contemporary United States. Summaries of these achievements, supported by studies in contributing disciplines evince some valuable beginnings to an understanding of art as an institution.

Research of several sorts has come to be concentrated recently in the field of mass communication and the so-called "popular arts" in America -- jazz and sweet music, best-sellers and periodical fiction, films, radio drama, and the like. Considering the extensive appeal of these forms of social action, and the enormous social area over which they communicate, from business to education and government to religion, the sociology of art can hardly afford to ignore, on any fiat of aesthetic snobbery, these crucial aspects of its province.

A sophisticated sociology of art will find it expedient to invoke certain competencies usually associated with other disciplines. Aesthetic criticism and, among the social sciences, psychology (social psychology in particular) have made the most extensive contributions to an understanding of art as an institution. These and other disciplines are eminently suited to an assisting role in sociological research. The sociologist must develop the findings of other disciplines into an imputative system of groups and relations in which art plays social roles comparable to those of other institutional factors.

Microfilm \$8.25; Xerox \$28.40. 649 pages.

# A STUDY OF THE OUTCOMES OF COLLEGE EDUCATION IN ART IN SELECTED COLLEGES IN TWELVE WESTERN STATES

(L. C. Card No. Mic 59-818)

James Roman Andrus, Ed.D.  
University of Colorado, 1958

Supervisor: Professor H. H. Mills

With the growth of art programs and the increase of studio classes in colleges, the problem of what outcomes should receive emphasis in the total program has become more basic than ever to evaluation. The primary purpose of this study was to make a contribution to objective and valid criteria for the evaluation of college art programs. To accomplish this, the study sought to identify major outcomes from education in art in college, to ascertain the relative emphasis these outcomes should receive in the college art program, to determine the extent to which these outcomes have been achieved in college, and to interpret some specific incidents in art in college from which might be formulated some critical requirements for more effective art training.

From a survey which was made of the literature published in the past twenty years in the fields of art, aesthetics, and art education, various concepts were abstracted which were stated by a majority of writers as kinds of knowledge, attitudes, and proficiencies which, ideally, college graduates in art should possess. Twenty-eight concepts representing the seven general areas of intellectual, psychological, manual, appreciational, educational, social, and integrational aspects of art education became the basis from which three questionnaires were constructed.

Responses to the first questionnaire produced data showing the relative emphasis a jury of thirty-three art specialists, who represented a wide specialty and geographical distribution, indicated should be given the twenty-eight outcomes, and the degree of achievement of these outcomes to be expected in the college art program. Responses to the second questionnaire produced data showing the relative emphasis one hundred and forty-five art teachers from colleges and universities in twelve western states, indicated should be given the twenty-eight outcomes, and the degree students had achieved these outcomes. Responses to the third questionnaire from four hundred and seventy-eight 1954-55 and 1955-56 graduates with degrees in art or art education from colleges and universities in twelve western states, produced data to indicate the extent to which students had achieved the twenty-eight outcomes in college. Students also reported critical assisting or thwarting incidents which had happened in college.

The assumption that all of the twenty-eight outcomes expressed important concepts and were desirable, received verification in the responses of the jury of art specialists and the art teachers. Outcomes concerned largely with highly creative factors of development involving self-orientation, self-discipline, and value judgments were placed highest on the scale of importance. Art specialists were more emphatic, whether higher or lower, in reactions to the importance of outcomes. For fourteen of the twenty-eight outcomes, the art specialists placed the level of achievement expectancy higher than the level of achievement scored by either the art teachers or the students. For thirteen of the twenty-eight outcomes, the importance rating



exceeded the achievement rating. The greatest differences between importance rating and achievement rating were shown for the outcomes, independent creative thinking as a part of art work, and synthesizing of ideas, feelings, and skills in creative work.

Reports of critical incidents placed direct instructor influences and personal achievement of students as the most potent forces for assisting achievement in art, and inadequate instruction and student inadequacies as the most thwarting factors in art education.

Responses indicated no one area of the college art program should be emphasized to the exclusion of any other area, but that programs should be planned to encourage more creative expression and critical thinking, in stimulating, friendly, and challenging atmospheres, where ideas, feelings, and skills of art have meaning as an integral part of life. Microfilm \$4.35; Xerox \$14.60. 340 pages.

#### URBAN REDEVELOPMENT IN CANADA

(L. C. Card No. Mic 59-119)

Kevin James Cross, Ph.D.  
Cornell University, 1958

This study is concerned with an analysis of urban conditions in Canada in relation to federal, provincial and local programmes, in an attempt to establish a series of recommendations for a comprehensive national programme of urban redevelopment. Urban growth as a result of rapidly increasing population is generating complex problems of new development in outlying urban areas as well as of redevelopment of the older urban centres. The viewpoint is taken that these problems are inextricably inter-related and that the redevelopment of urban central areas must therefore be complemented by planned patterns of new urban growth within the structure of the entire metropolitan area, or urban region.

The objectives of the study were: (1) to analyze the Canadian urban redevelopment situation at the national, provincial, and local levels, and to correlate the observed data; (2) to compare Canadian urban redevelopment experience with the more mature experience of the United States and England; (3) to detect weaknesses and inadequacies in the Canadian programme; (4) to make a series of proposals in regard to a comprehensive national urban redevelopment programme; and (5) to establish a comprehensive bibliography of Canadian urban redevelopment references.

All of the pertinent federal and provincial agencies, as well as many local agencies and private individuals were contacted for advice, references, and viewpoints. The author was employed in the Planning Department of Central Mortgage and Housing Corporation, (the national housing agency), during the summer of 1957, when most of the research on Canadian aspects of the study was undertaken.

Since urban redevelopment is in its infancy in Canada, it was necessary to investigate the legislation available, with its financial provisions, the administrative structure, and planning objectives for urban redevelopment. Selected aspects of urban redevelopment in England and the United States were also examined, since these countries have many problems similar to those found in Canada. The

Canadian situation was examined at the Provincial and local levels to a limited extent. Proposals in regard to future Canadian redevelopment activity, although restricted mainly to planning legislation, objectives, and administration, were made in an attempt to define a comprehensive redevelopment programme for Canada. Selected bibliographies on urban redevelopment for the three countries are included.

About 450,000 of Canada's 4,000,000 dwellings are sub-standard and many are concentrated in blighted areas which urgently require redevelopment. The extent of cities is expected to double by 1980, and local governments are facing unprecedented demands for urban facilities. The national economy is such that demolition of substandard housing may proceed on a programmed basis. Urban redevelopment studies have been undertaken in Halifax, Saint John, Montreal, Winnipeg, Vancouver and Toronto; however the only completed project is Toronto's Regent Park North Project.

A National Planning Act is proposed to establish positive planning objectives, policies, and programmes. This would be administered by a proposed Federal Department of Planning, which would evaluate and meet planning needs and would also integrate activities of various Federal Departments. The Act would have as its objective the planned development of Canada by providing technical, financial, and administrative assistance to regional and local authorities. The Act would promote maximum development of national resources. Existing legislation should be broadened to allow redevelopment of urban land from any existing use to that most suitable for the community. A greatly increased programme of planning education is recommended to relieve the personnel shortage. Increased public education is essential. It is recommended that current permissive Provincial legislation be replaced by positive planning requirements. A comprehensive approach must be taken to ensure effective redevelopment in Canada.

Microfilm \$9.35; Xerox \$33.40. 739 pages.

#### GEERTGEN TOT SINT JANS AND THE HAARLEM SCHOOL OF PAINTING

(L. C. Card No. Mic 58-7889)

James E. Snyder, Ph.D.  
Princeton University, 1958

The earliest surviving monument of the Haarlem School of Painting is the Berlin Raising of Lazarus by Albert van Ouwater, dateable ca. 1450-1460. The earlier history of Haarlem's art cannot be reconstructed, but stylistic relationships between Ouwater's one painting and the Prado Nativity Altar, generally attributed to Dirk Bouts, demonstrate the close collaboration of these two artists somewhere in the 1430ies or 1440ies, perhaps in Haarlem before Bouts had moved to Louvain. Furthermore, two late copies of Ouwater's Separation of the Apostles, described by van Mander as a "landscape with pilgrims", show that the famed but lost landscape style of Ouwater resembled in both method and formula that employed by Bouts.

A little known painter, the Master of the Tiburtine Sibyl, continued the Ouwater-Bouts tradition in Haarlem. Trained in Louvain as a pupil of Bouts, this master turned up at Haarlem in the 1480ies where his paintings show a gradual



Haarlemizing. It was his shop that provided the woodcut designs for the illustrated books printed by J. Bellaert in Haarlem from 1483-1486.

The most outstanding representative of the Haarlem School is Geertgen tot Sint Jans. Both his stylistic inventions and his rich iconographic programs merit Geertgen a position beside the accepted leaders of Netherlandish painting. By a careful investigation into the archival and historical remains a more precise dating for Geertgen's activity can be determined (ca. 1475-ca. 1495). The foundation of the first Netherlandish Confraternity of the Rosary in Haarlem in 1478 provided Geertgen with new patrons, and it can be demonstrated that it was for Commandeur Johann Willem Janssen (1484-1514) that Geertgen painted the great Altarpiece for the Knights of Saint John of which two panels survive in Vienna.

The strong influence of the early works of Hugo van der Goes, especially the *Monforte Adoration of the Magi* in Berlin, would suggest that Geertgen had received early training in Flanders perhaps in Bruges as a miniaturist. Geertgen's iconographic motifs and his curious brush technique also show the influence of miniature painting, yet it was

from Ouwater that he learned to arrange figures solidly in space. Geertgen developed the static Gothic landscape constructions of Bouts and Ouwater into a flowing and unframed depiction of natural landscape, and he transformed the colourful, heavily draped figure types of his forerunners into new, specifically Dutch personalities.

In temperament and personality Geertgen appears as a mystic. In the attempt to break down the barrier between the picture frame and the spectator, Geertgen employed three stylistic devices: the "Andachtsbild"-motif (Vienna Lamentation), Fractional-figures (Utrecht *Man of Sorrows*), and Mystical Illumination (London *Night Nativity*). Geertgen cannot be considered simply as a provincial pioneer. He emerges from the welter of late 15th century schools of painting as an impressive individual genius with a rich background in both the North- and the South-Netherlands, and the natural talent to absorb, assimilate, and enrich whatever traditions appealed to him.

The problems of stylistic attribution, chronology, and iconography of the individual paintings are handled separately in a catalogue raisonné of Geertgen's paintings.

Microfilm \$4.55; Xerox \$15.20. 354 pages.

## FOOD TECHNOLOGY

### STUDIES ON THE ADSORPTION OF SURFACE ACTIVE AGENTS BY *STAPHYLOCOCCUS AUREUS*

(L. C. Card No. Mic 59-516)

Horace Delbert Graham, Ph.D.  
University of Illinois, 1958

Though it has been widely postulated as a preliminary step in the action of surface active agents on bacteria, few comprehensive experiments on the adsorption of surface active agents by bacteria have been reported. Studies, therefore, were initiated in an attempt to investigate, quantitatively, the adsorption of cetyl pyridinium chloride and sodium lauryl sulfate by *Staphylococcus aureus*.

These studies necessitated the use of a highly sensitive test for the surface active agents used.

After a thorough evaluation of all the influencing factors, the bromphenol blue method was modified to permit consistent and accurate micro determination of cetyl pyridinium chloride. 20 mls. of 0.5M  $K_2HPO_4$ - $KH_2PO_4$  buffer of pH 8.5 were pipetted into a separatory funnel, 5 ml. of a solution of cetyl pyridinium chloride or a properly diluted unknown sample were added, then 1 ml. of a freshly prepared 0.04% bromphenol blue solution. The contents were mixed well and then 15 ml. of benzene added. The funnel was shaken on a Burrell wrist action shaker for 25 minutes. It was then permitted to stand for 5 minutes to allow separation of the aqueous and benzene layers. The benzene layer was run off, centrifuged at 1000 r.p.m. for 2 minutes, and 30 minutes later the color intensity measured on a Coleman Model 11 Universal Spectrophotometer at 610 mu with commercial benzene as the blank. Recovery of bound cetyl pyridinium chloride from bacterial systems was achieved by color measurement after acid digestion of the samples.

A method was developed for sodium lauryl sulfate based on the reaction of sodium hypochlorite and ortho-tolidine at pH  $3.5 \pm 0.1$  in 3N phosphate buffer to form a haloquinone which in turn couples with the surfactant at pH  $3.0 \pm 0.1$  to form a purple color, the intensity of which is proportional to the amount of sodium lauryl sulfate present. 27 ml. of 3N  $NaH_2PO_4$ - $H_3PO_4$  buffer, pH  $3.5 \pm 0.1$  are placed in a 100 ml. test tube. 1 ml. of a  $300 \pm 7.5$  p.p.m. sodium hypochlorite solution and 2 ml. of 0.1% ortho-tolidine solution in 10% HCl are added. Two minutes afterwards, 50 ml. of the sodium lauryl sulfate solution are added and 10 minutes later, the color intensity is measured at 590 mu with phosphate buffer as the blank.

Recovery of sodium lauryl sulfate from bacterial systems was achieved by alkaline digestion of the sample followed by filtration over alkali-treated asbestos filters.

The adsorption studies were performed at 30°C for 5 minutes in 0.01M phosphate buffer at various pH levels. Bacterial cells were removed by centrifugation at 2500 r.p.m. for 10 minutes. The amount added minus the amount in the supernatant gave the amount of the surfactant apparently adsorbed. A plot of the amount in the supernatant vs. the amount apparently adsorbed gave the uptake curve of the surfactant at the particular pH.

The uptake curve for cetyl pyridinium chloride by *Staphylococcus aureus* was found to be of the Langmuir adsorption multilayer type. The uptake was pH dependent, reaching a maximum at pH 7.6. Added cetyl pyridinium chloride was found to be in the bound and free forms both in the supernatant and associated with the cells. The bound portion in the supernatant was complexed with ether-extractable, presumably lipoidal material(s), and could be released by acid digestion. The reversibly adsorbed cetyl pyridinium chloride on the surface of the cells was probably present in the form of micelles. Sodium lauryl



sulfate was taken up by the cells at pH 2.4, 2.8, and 6.8 in a multilayer fashion also resembling adsorption isotherms. At pH 2.4 up to 96% the adsorbed material could be eluted. At pH 6.8 only 32-58% of the apparently adsorbed sodium lauryl sulfate was elutable indicating considerable irreversible binding and absorption occurred due to the extensive

centrifugation time necessary. Micelle formation and cytolytic injury were found to occur under the conditions of the experiments. At pH 6.8, 13.3% of the bacterial nitrogen leaked out due apparently to extensive cytolytic injury at the very high level of surfactant used.

Microfilm \$2.00; Xerox \$6.80. 142 pages.

## GEOGRAPHY

# AN ANALYSIS OF THE CONTEMPORARY AGRICULTURAL GEOGRAPHY OF THE ÇUKUROVA

(L. C. Card No. Mic 59-210)

John Hiltner Jr., Ph.D.  
Northwestern University, 1958

Supervisor: E. B. Espenshade

This study is an analysis of the contemporary agricultural geography of the Turkish Çukurova. The various types of agricultural occupance in the Çukurova are described, the factors which might have resulted in these types of agricultural occupance are analyzed, and the future agricultural development of the area is hypothesized.

The Çukurova is divided into three sub-regions: the Adana - Tarsus Cotton Sub-Region which includes those parts of the Çukurova in which at least forty percent of the total area is cultivated, at least fifty percent of the cultivated area is planted in cotton, but less than twenty percent of the total area is planted in cereals; the Upper Ceyhan Cotton - Cereal Sub-Region which includes those sections of the Çukurova in which at least forty percent of the total area is cultivated and at least twenty percent of the total area is planted in cereals; and the Peripheral Mixed Farming Sub-Region which includes the remainder of the Çukurova.

Three types of agricultural occupance are found in the Adana - Tarsus Sub-Region. One of these is *köylü* agriculture in which a large variety of crops are cultivated on small fragmented, but operator owned, land holdings in semi-isolated villages. Much of the agricultural produce remains in the village and farming practices are primitive. The second is *çiftçi* agriculture in which cotton, wheat, and rice are produced on large owner managed land holdings and sold on the commercial market. On these farms several of the production operations may be mechanized but few techniques of scientific production are utilized. The third is modified *köylü* agriculture in which fruits, vegetables, cotton, and wheat are produced commercially on small land holdings.

Both *köylü* and *çiftçi* agriculture are found in the Upper Ceyhan Sub-Region but modified *köylü* agriculture is not common. In this sub-region cotton is less dominant than in the former and the various cereal crops assume a greater importance.

In the Peripheral Sub-Region many of the people are pastoralists who also farm small plots of cereals and vegetables. However, in two small districts the commercial production of fruits and vegetables is the principal agricultural activity.

Although climate has been a favorable factor for the agricultural development of the Çukurova, the differences from place to place within the area have resulted chiefly from terrain and soil differences and the degree of accessibility of the farmer to transportation facilities and markets. In those areas where local relief is slight and where markets are accessible, *çiftçi* agriculture has developed. *Köylü* agriculture is dominant in those areas where local relief is great, where markets are inaccessible or where the opportunities to accumulate surplus capital are slight. Modified *köylü* agriculture is located in those areas where the accumulation of land has been restricted but markets for agricultural produce are accessible.

The agricultural economy of the Çukurova has expanded in the past two decades chiefly as a result of the availability of transportation to other parts of Turkey, the expansion of markets for agricultural produce, and the accumulation of land into large farms. However, the programs of the Turkish government to stabilize prices and remove many of the financial production and marketing risks have greatly facilitated the distribution of agricultural produce.

The future of the agriculture of the Çukurova appears bright. Markets are expanding and transportation both within the Çukurova and to other sections of Turkey is improving. However, it is doubtful whether the total volume of agricultural production will increase unless the area's farmers improve production practices and strive to increase yields and quality of product.

Microfilm \$2.90; Xerox \$10.00. 222 pages.

# THE INDUSTRIAL POTENTIAL OF THE CHAMPAIGN-URBANA AREA

(L. C. Card No. Mic 59-556)

James Edward Patterson, Ph.D.  
University of Illinois, 1958

It is the purpose of this study to evaluate the industrial potential of the Champaign-Urbana AREA. Situated near the center of East Central Illinois, the AREA is about one and one-half times as large as the state of Rhode Island and contains about 163,000 people. Champaign-Urbana is the geonomic hub of this AREA, which extends 15 to 35 miles in all directions.

Part I of the study is an explanation of the geographic approach to industrial location. Geographers hold that industrial location is largely the result of geographic differences from place to place in the cost patterns of doing



business. This study does not attempt to analyze the cost pattern of individual industries which might locate in Champaign-Urbana; rather it attempts to determine whether the Champaign-Urbana AREA has those areal qualities which enable the maximization of profits.

Part II introduces the AREA, locates it, and describes its physical and cultural environment. A brief history is followed by a detailed account of those institutions which have been significant in its economic growth and development. The first settlements occurred in the 1830's but rapid growth did not occur until the coming of the railroads in the 1850's. Since that time the AREA has grown and prospered primarily in response to its rich agricultural lands, the decision to locate the University of Illinois in Champaign-Urbana, and the decision to locate Chanute Air Force Base at Rantoul. Manufacturing has been of minor importance in the growth of the AREA. Until the last few years most of the manufacturing plants have been small and locally owned. The fact that the AREA has not grown industrially results not so much from the lack of resources or interest in manufacturing as from the community's overwhelming interest in agriculture, the University, and Chanute Air Force Base.

Part III includes a discussion of physical factors--weather and climate, soils, topography, and drainage--as well as other factors of prime consideration: labor, water, materials, transportation, and markets. Possibly the most serious physical handicaps are poor drainage and lenses of subsurface materials not suitable for foundations. The available quantity of labor varies from 1,400 to about 3,100. Female labor is available from the rural non-farm areas, from the University community, and from Chanute Air Force Base. University graduates and discharged Air Force personnel can be secured to serve as technicians and research personnel. The faculty of the University is available for consultation. Other labor can be secured via labor transfers from within the AREA without in-migration from nearby areas of surplus labor. Water is available from surface and subsurface sources, but large consumers of process water should be discouraged from locating in the AREA unless they can make good use of local materials. The primary materials available are corn, soybeans, oats, wheat, and chemicals. Good transportation from a centralized location results in a good market position.

Part IV summarizes the study and recommends certain steps which should be followed in the industrial development of the AREA. This study shows that the AREA does have industrial potential which can be developed if it is ever deemed necessary or desirable. Research type industries, processors of grain and their by-products, electronic and assembly types of industry as well as manufacturers of certain types of chemicals should be encouraged to locate in the AREA. Heavy industry requiring great depth and variety of materials, cheap water transportation, large quantities of process water or large numbers of workmen should be discouraged from locating in the AREA. Any industrial expansion should come about gradually so that adjustments can be made with a minimum disruption of community life and should occur in those fields in which the AREA can contribute to the success of industry.

Microfilm \$4.70; Xerox \$15.80. 368 pages.

## THE AGRICULTURAL LAND USE AND SETTLEMENT PATTERNS IN THE SABANA DE BOGOTÁ, COLUMBIA

(L. C. Card No. Mic 59-220)

Herbert Lawrence Rau, Jr., Ph.D.  
Northwestern University, 1958

Supervisor: Clarence F. Jones

The Sabana de Bogotá, the largest of the Andean altiplanos in Colombia, derives its unique regional characteristics from its physical environment, settlement patterns, and land utilization. Overcoming many of the limitations resulting from its isolated position in the Cordillera Oriental, the Sabana has become a crossroads connecting diverse regions. The Sabana has experienced rapid expansion of population and urbanization, the development of modern large-scale industries, and the intensification and modernization of farming and livestock raising.

The Altitude of the Sabana de Bogotá, between 8,550 and 8,875 feet, in the tropical highlands of the Andes, gives to the altiplano a mild climate called, descriptively, Tierra fría. The Sabana is nearly flat and relatively poorly drained. It is comprised of a large open plain and several small tributary valleys separated from each other by the fingerlike extensions into the plain of the surrounding Cordillera. Although the plain appears to be flat, there are three terrace levels (1) the terrazza alta: about 15.2 percent of the plain, (2) the terrazza intermedia: about 57.4 percent of the plain, and (3) the terrazza baja: about 26.4 percent of the plain.

Population of the Sabana de Bogotá is urban-oriented in cities, towns, villages, and hamlets, as well as in the burgeoning metropolis of Bogotá. The rural population constitutes only about 6 percent of the total population in the plain, and is unevenly distributed across the plain. Over 13 percent of the population lives in the densely settled marked garden areas adjacent to urban places where rural population approaches urban densities. Bogotá, with over 700,000 persons, includes 81 percent of the total population. Urban places function as farm market centers, focal points for transportation routes, centers of mining activities, government centers, and manufacturing and processing centers.

The principal use of land, about 58 percent of the Sabana de Bogotá, is for pasture to support the livestock industries. Livestock graze on both poor to fair natural pasture grasses, and good planted pasture grasses. Livestock are principally milk breeds--Holstein-Friesian, Brown Swiss, Jersey--or dual-purpose breeds--Normandy and Red Poll. Beef and dairy cattle are pastured the year around on large pastures. Many cattle are grazed on poorly managed pastures which are often either overgrazed or undergrazed. In general, the density of cattle per unit of area is low.

Large-scale, extensive, commercial use of land for grain crops contrasts with small-scale, intensive, subsistence use of land for grain and a variety of market garden crops. The cultivation of the commercial grain crops is concentrated in areas of sparse rural population on the intermediate and lowest terrace level where the more fertile soils of the altiplano give excellent yields of wheat, barley, maize, and potatoes. The most common problems which beset all crops are short season growth, developing



a two-crop cycle, drought danger, insect pests, and disease. The cultivation of subsistence and market garden crops is concentrated in areas of (1) greatest rural population concentration, (2) greater slopes and excessively drained areas, (3) relatively poorly drained sites subject to flooding. Major emphasis is placed on the cultivation of basic

food crops--maize, potatoes, wheat, beans, and a variety of lesser garden crops--in the cropping systems of the subsistence and small commercial farming units. Small field plots, field methods, and soil preparation affect the yields of the small farms and tend to exploit and exhaust soil fertility. Microfilm \$5.00; Xerox \$16.80. 391 pages.

## GEOLOGY

**THE GEOLOGY OF THE  
ANSON QUADRANGLE, MAINE**

(L. C. Card No. Mic 58-3093)

Anthony Robert Cariani, Ph.D.  
Boston University Graduate School, 1958

Major Professor: Professor Caleb Wroe Wolfe

The Anson quadrangle is located in west-central Maine in a region which offers complex problems in structural geology, petrology, and stratigraphy. The geomorphology is also considered in this study.

The formations which make up the stratigraphy of the quadrangle include the following (from oldest to youngest): The Perry Mountain, Parmachenee, Madrid. Two formations of uncertain age are the Kennebec and Anson formations. The Perry Mountain formation, which outcrops only in the extreme northwest corner of the quadrangle, is composed of well bedded quartzites intercalated with sandy biotite-muscovite schists and staurolite schists. The Parmachenee formation consists of thinly bedded gray phyllites, impure biotite quartzites and black limestones. The formation contains notable amounts of pyrite and pyrrhotite. The Madrid formation is composed predominantly of calcareous quartzite with lime-silicate minerals in the middle grade metamorphic zones. The formation contains only minor amounts of argillaceous rocks and calcareous beds; sulfides are absent or inconspicuous. The quartzites grade upward into the Dyer Hill member which is composed of chloritoid-bearing black slates. The Kennebec formation is composed of thinly bedded black sulfide-rich limestones, phyllites and quartzites. The Anson formation consists of brown-mottled grits and arenaceous phyllites. The brown spots are caused by the oxidation of siderite. The position and formational status of the Kennebec and Anson formations are still in doubt. The Anson formation correlates on the basis of similar lithology with the Vassalboro formation in the Vassalboro quadrangle. This latter formation is Clinton in age.

The edge of two intrusive bodies project into the quadrangle - the Black Hill pluton and the Sandy River pluton. Only one phase is present, quartz monzonite, which varies in texture from medium to coarse grain.

The rocks near the Black Hill pluton show distinct contact metamorphic effects, including the presence of andalusite. The low-grade regionally metamorphosed rocks are restricted to the south and southeast portions of the quadrangle, while the middle-grade metamorphic zone is found in the north and northwest area. There is no well-defined garnet isograd.

The relationship of the siderite to the sulfides is described in detail. Siderite is formed at an oxidation potential higher than that needed for pyrite. The sideritic rocks formed near the shore of a marine basin where more oxygen was available. The pyrrhotite in this region was considered to have been formed from pyrite under metamorphic conditions. An alternate explanation is suggested: namely, that initial sulfide from which the pyrrhotite formed may have been FeS rather than FeS<sub>2</sub>. This would involve a subtraction of iron from the primitive FeS to form the pyrrhotite. The rocks containing the sulfides were formed in a strongly reducing environment, probably a barred basin with restricted circulation.

The major fold structures trend northeast-southwest. The axial planes of the folds are vertical or slightly overturned and in the latter case dip to the northwest. The absence of noses of folds and the consistently steep dip of the beds may also be explained in terms of pleated folding. No large scale faulting has been observed in the quadrangle, although minor longitudinal faulting is not uncommon.

Glaciation modified the pre-existing topography slightly by deposition and erosion. Glacial striations trend between S 20° E and S 30° E. Post-glacial geomorphic features, which include alluvial terraces, falls, ice push, discordant junctions, and sand dunes are all described and their origins are discussed. The marine limit in the quadrangle is considered to be at least at the 400-foot elevation as evidenced by marine fossils found just south of the Anson quadrangle. Microfilm \$2.60; Xerox \$9.00. 200 pages.

**PENNSYLVANIAN SPORE SUCCESSION  
IN TENNESSEE**

(L. C. Card No. Mic 59-491)

Frederick William Cropp, III, Ph.D.  
University of Illinois, 1958

Sixty-six coals from Tennessee have been macerated and the spore assemblages of 15 of the coals have been studied. These 15 coals were chosen to give a stratigraphic representation of the various portions of the Pennsylvanian section exposed in Tennessee from the oldest coal which could be found to the youngest coal obtainable.

Judging from the quality of spores obtained from macerated samples, all the coals are amenable to the maceration process, yielding abundant spores which are useful for age determination, correlation, and for distinguishing coals from one another.



Twenty-two previously described and several undescribed or unnamed spore genera were observed in the macerations. *Lycospora* was the most abundant genus in nine of the 15 coals, *Laevigatosporites* was the most abundant genus in four of the coals, and *Densosporites* and *Granulatisporites* were the most abundant genera in one coal.

The 15 coals can be distinguished from one another on the basis of the spores identified to the generic level. This is accomplished by comparing histograms of the spore distribution in each coal and by observing the distribution of the spores throughout the 15 coals. Even when two or more coals have the same percentages or nearly the same percentages of the dominant spore genera, there is usually a prominent minor member of the spore assemblage or several different genera present in one coal to distinguish it from the others.

On the basis of the presence of *Densosporites* in the youngest coal, it has been found that all of the coals in Tennessee are Caseyville and Tradewater in age using the Eastern Interior Basin terminology and Pottsville or lowermost Allegheny in age using the Appalachian terminology.

Microfilm \$2.00; Xerox \$5.20. 102 pages.

#### TEXTURES OF LOWER PALEOZOIC ROCKS OF NORTHEASTERN BRITISH COLUMBIA

(L. C. Card No. Mic 59-502)

John Kerby Eccles, Ph.D.  
University of Illinois, 1958

Lower Paleozoic strata, ranging from Cambrian to Devonian are found throughout the front ranges of the Rocky Mountains of British Columbia. Two measured sections, approximately 310 miles apart in Northeastern British Columbia were studied, one consisting of 3075 feet, the other of 9,500 feet of interbedded sandstone, limestone, and dolomite. They are sparsely fossiliferous. A microfacies analysis of these sections suggests a tentative correlation of the strata.

Thin section studies indicate that textural correlation of the Lower Paleozoic strata of this area cannot be made. There are twelve main types of texture present but none is unique to a part of the sections.

Analysis of the clasticity and frequency of the constituent components, when used in combination with interpretation of the environment of deposition, showed that cyclic sedimentation occurred and suggested four major transgressions above the first thick massive sandstone in each section.

A study of the relations of dolomite, calcite, and secondary quartz indicates that dolomite occurs first, then quartz and calcite. Dolomite replaces calcite and quartz; calcite can replace quartz.

Study of the iron minerals and quartz indicates that the iron minerals are not solely a result of detrital accumulation. The wavy extinction of the quartz indicates a metamorphic provenance such as the Precambrian shield to the east.

Microfilm \$2.00; Xerox \$5.00. 97 pages.

#### PRECAMBRIAN GEOLOGY OF THE FRONT RANGE NEAR THE MOUTH OF BIG THOMPSON CANYON, COLORADO

(L. C. Card No. Mic 59-799)

Belva D. Hudson, Ph.D.  
University of Colorado, 1958

Supervisor: Professor Ernest E. Wahlstrom

The described area, 27 miles north of Boulder and 8 miles west of Loveland, Colorado, includes a portion of the eastern edge of the Front Range and contains Precambrian metasediments and igneous rocks unconformably overlain by eastward-dipping Pennsylvanian and younger sedimentary formations. The north-trending Precambrian-Pennsylvanian contact is offset by two northwest-striking high-angle reverse faults which die out to the southeast in folds in the sedimentary rocks.

The Big Thompson metasediments are the oldest rocks in the area and probably correlate with rocks of the Idaho Springs formation exposed in other parts of the Front Range. Quartzite, micaceous quartzite, feldspathic quartzite, quartz schist, and mica schist are inter-bedded in a relatively undeformed sequence at least 13,000 feet thick. A few conglomeratic quartzites are present. Quartzites predominate in the northern and central parts of the area, and mica schist is the most abundant rock type in the southern part.

The quartzite typically is fine-grained, dark-grey, and finely laminated. Graded bedding, ripple marks, and well-developed cross-bedding were not observed. The feldspathic quartzites are coarser-grained and less well sorted and laminated. In the conglomeratic quartzites, quartz pebbles are embedded in a fine-grained micaceous matrix. The schist contains muscovite, quartz, and biotite. Most of the metasediments contain small amounts of chlorite, tourmaline, zircon, apatite, and magnetite.

Cleavage cuts across the bedding throughout the area, and has two main orientations. In the northern and central parts of the area, where quartzite predominates, the cleavage strikes northwest and dips steeply southwest. In the southern area of mica schists the cleavage trends northeast and dips about 60° to the southeast. Except for local deviations, the bedding everywhere strikes west-northwest and dips steeply to the south. The cleavage probably formed during large-scale regional folding of the metasediments. The cleavage is parallel to the axial planes of the few small folds which were observed. In the quartzites schistosity is parallel to the bedding, but in the mica schists it is more commonly parallel to the cleavage and may be crenulated.

The oldest intrusive rocks are a few conformable amphibolite bodies which appear to be sills. The amphibolite is completely recrystallized and contains poikiloblastic plagioclase and hornblende, biotite, quartz, magnetite, zircon, and apatite. Cutting the amphibolite bodies are unmetamorphosed andesite and diorite dikes which trend north-northwest and are nearly vertical. Heat from the thicker dikes partly melted some of the metasediments which, in turn, intruded the jointed and solidified dike borders.

The youngest igneous rocks in the area are Precambrian tonalite, microtonalite, and dacite porphyry. The tonalite occurs as small stocks and thick sills; the microtonalite and dacite porphyry as border facies of tonalite



bodies and as thin sills. The tonalite magma was gently intruded so that most inclusions of metasediments were undisplaced. Two large antecedent andesite and diorite dikes are partly preserved within tonalite bodies. The relative ages of the andesite and tonalite are indicated by angular inclusions of andesite in tonalite and by tonalite veins cutting andesite. The dikes were unaffected by the heat of the tonalite, and were apparently strong enough to support themselves during engulfment by the tonalite magma.

A relatively featureless surface, cut by a few shallow stream channels, developed on the Precambrian rocks before deposition of the Pennsylvanian Fountain formation. A hematite-stained zone of Precambrian rocks which underlies the unconformity probably resulted from pre-Pennsylvanian weathering.

Microfilm \$2.00; Xerox \$5.20. 102 pages.

**MINERALOGY AND STRATIGRAPHY OF THE  
TEMISCAMIE IRON-FORMATION, LAKE  
ALBANEL IRON RANGE, MISTASSINI  
TERRITORY, QUEBEC, CANADA**

(L. C. Card No. Mic 59-1293)

Terence Thomas Quirke, Jr., Ph.D.  
University of Minnesota, 1958

The Lake Alanel area is located about 400 miles north of Montreal and includes about 1,900 square miles. The area of the Lake Alanel Iron Range comprises between 150 and 175 square miles. Since 1952 the area has been under intensive investigation. Geophysical surveying, geologic mapping, diamond drilling and laboratory investigations including x-ray, thin and polished section studies have been carried out.

All consolidated rocks in the area are of Precambrian age. Several new names have been assigned to local rock units. The oldest rocks in the area are sediments and volcanics lying to the north of the Lake Alanel Iron Range. They are named here the Lake Sam Gunner group. These sediments have been intruded by granites and gneisses which comprise the Takwa Mountains complex, as named here. These rocks were dated by the K-A method as 1.7 b. y. Resting with angular unconformity upon these rocks is the previously named Papaskwasati group of sediments. These rocks in turn are conformably overlain by the Mistassini group (Mistassini series of previous authors). The Mistassini group has been dated as 1.3 b. y. All these

groups lie to the northwest of the Grenville Fault. The Grenville complex to the southeast of the fault consists of acidic and basic intrusions, orthogneisses and paragneisses. These rocks have been dated as 1.03 b. y. Sediments which were metamorphosed to produce the Grenville complex may have been deposited adjacent to the Papaskwasati and Mistassini sediments.

The Mistassini group consists of five formations. The Boulder Bay quartzite formation has not been mentioned previously in the literature. The Temiscamie iron-formation has been divided into six members which are defined and described in detail. From oldest to youngest these are: lower argillite (1), lower sideritic chert and iron silicate (2), magnetitic hematitic sideritic-dolomitic chert (3), upper stilpnomelane argillite (4), fine-bedded magnetitic iron silicate (5) and upper sideritic chert (6).

The proposed environment of deposition of the members of the iron-formation is a modification of that proposed by other authors. The following units were deposited concurrently and are, in order of increasing distance from shore: Boulder Bay quartzite formation, lower argillite member (1) of the Temiscamie iron-formation, lower sideritic chert and iron silicate member (2), magnetitic hematitic sideritic-dolomitic chert member (3) and upper stilpnomelane argillite member (4). The quartzite was deposited near shore in shallow water. The two argillites (1 and 4) were deposited in fairly deep water, while the sideritic chert and magnetitic members (2 and 3) were deposited between these two in shallower water. Because of the deepening water during the later stages of deposition the oxides ceased to form. The fine-bedded magnetitic member (5) was deposited in an environment similar to that of the upper argillite (4). The carbonate continued to be deposited and was eventually overlain by the slates and graywackes of the Kallio formation.

Minerals of the iron-formation probably were formed from an original silica gel rich in iron and carbonate. The first minerals to form were chert, siderite and in some cases hematite, magnetite and perhaps minnesotaite. Each bed of the iron-formation is considered to have been essentially a closed system after deposition. Due to the incorporation of iron into the early minerals there was a subsequent enrichment of magnesium, manganese and calcium in the remaining uncrystallized material. These three crystallized into a dolomitic structure. Stilpnomelane formed from the abundant iron and silicon using the aluminum, potassium and magnesium which were available.

Chemical analyses have been made of each of the members of the Temiscamie iron-formation. The analyses have been used to compare these members with similar rocks of other Precambrian iron-formations.

Microfilm \$2.00; Xerox \$7.00. 147 pages.



## HEALTH SCIENCES

### HEALTH SCIENCES, GENERAL

#### CUMULATIVE EFFECTS OF REPEATED EXPOSURE TO HIGH-INTENSITY TONES UPON RECOVERY OF AUDITORY SENSITIVITY

(L. C. Card No. Mic 59-200)

Vernon Chaplin Bragg, Ph.D.  
Northwestern University, 1958

Supervisor: Raymond T. Carhart

Relative measures of temporary threshold shift and of recovery time following acoustic stimulation have provided the basis for a number of proposed tests of noise-susceptibility. More recently, the cumulation of recovery time following repeated exposures has been suggested as a basis for such a test. Because of the interest in recovery from temporary threshold shift, this investigation was designed to study the progress of measurable accumulation in recovery time as such accumulation develops following successive exposures to tonal stimulation at various intensities.

Cumulative delay in recovery time was effected by presenting four series of twenty one-minute exposures of a 3000 cps tone to each subject. Each series of exposure tones was presented at one of four sound pressure levels: 85 db, 90 db, 95 db, or 100 db re .0002 microbar. Twenty subjects with normal hearing were employed, but only one ear per person was stimulated. The order of presentation was randomized separately for each subject. Recovery time was measured in seconds from the cessation of the (3000 cps) exposure tone to the reappearance of a pulsed (4500 cps) trace tone at 20 db above pre-exposure level. As soon as the subject responded at this level, the trace tone was reduced in intensity by 10 db, and the measurement of recovery time continued until this new level was audible. Immediately thereafter, the exposure tone was again introduced, and the sequence repeated. A single experimental session consisted of twenty such exposures and measurements of recovery time.

The cumulative exposure seemed to evoke four stages of subject response.

Following repeated exposures to the 85 db tone, recovery time to both 20 db and 10 db failed to exhibit any measurable accumulation. That is, recovery time following the twentieth exposure was of the same magnitude as recovery time following the first exposure. Because cumulation is considered the mark of a fatigue phenomenon, it was concluded that this level of exposure evoked only adaptation.

Exposure at the 90 db and 95 db levels resulted in moderate cumulation in the recovery time with repeated insult. In the case of the 90 db exposure level, the cumulation failed to reach statistical significance, although it was apparent to the eye when the data were graphed. These responses appear to represent a transitional stage between adaptation and cumulative fatigue.

When the 3000 cps tone was presented at 100 db sound pressure level, a marked increase was noted in the cumulation of recovery time. Such cumulation clearly bespeaks a fatigue phenomenon.

Finally, two subjects, when exposed to the 100 db tone, failed to recover to the 10 db level within an arbitrary five-minute time limit. It was presumed that further exposure at this level might have resulted in permanent loss. Therefore, the test was stopped at this point.

Two major conclusions emerge from the findings of this study.

First, the pattern of recovery time curves appears to confirm the concept of a critical intensity. Specifically, under the conditions of the study, it appears that a different mechanism of cumulation is responsible for the responses to exposures in excess of 95 db than for those below this critical level. It is concluded that 95 db represents a critical intensity below which adaptation is evoked, and above which cumulative fatigue is effected.

Second, it was concluded that only those responses which resulted from exposures in excess of the critical intensity showed promise for use in a test of noise-susceptibility. That is, measurement of individual differences in cumulative auditory fatigue form a better basis for a practical test of noise-susceptibility than measurement of differences in adaptation.

Microfilm \$2.00; Xerox \$6.80. 143 pages.

#### A COMPARISON OF THE EFFECTS OF FRACTIONATED THERAPEUTIC DOSES OF X-IRRADIATION UPON NEOPLASMS AND NORMAL TISSUES

(L. C. Card No. Mic 59-789)

William Dwight Carlson, Ph.D.  
University of Colorado, 1958

Supervisor: Professor Raymond R. Lanier

This problem was undertaken to determine the optimum fractionation of roentgen doses required to destroy a neoplasm permanently while causing the least possible damage to the normal tissues.

In 1944 Strandqvist analyzed the relationship between total dose and overall elapsed treatment time using daily radiation exposures in 280 cases of carcinoma of the skin and lip. Strandqvist used these data to plot a curve of the no-complication and no-recurrence data, which is hereafter referred to as Strandqvist's fractionation iso-effect curve.

The conclusions to be drawn from the review of the literature are: 1) Fine fractionation of the total dose of radiation appears to spare normal tissues to a larger extent than the same or larger doses applied in single-exposure, or in coarse fractions; 2) fine fractionation of radiation



appears to damage squamous cell carcinoma more than it damages the adjacent normal tissues; and 3) coarse fractionation may have advantages in the treatment of adenocarcinoma.

The doses and treatment schedules used in this study were selected from Strandqvist's fractionation iso-effect data. This actually was a test of the validity of empirical impressions of radiotherapists that the time-dose relationships for skin neoplasms can be used on some other neoplasms in other locations.

In the present study the effects of various methods of fractionation of a total dose of radiation were investigated by two methods upon two types of mouse tumors. These were E 0771 mammary adenocarcinoma in C57 B1/6 mice in Experiments One through Six, and Ehrlich ascites tumor (a carcinoma) in the solid form in A/He white mice in Experiments Seven through Nine. The mice used in these experiments were between the ages of four and ten weeks. All were males. To irradiate the tumor and not the whole mouse, special lead tubes (three millimeters thick) were used. The mice were placed in the tubes so that the leg bearing the tumor on the lateral surface of the thigh region protruded from a hole in the end of the tube.

The mouse tumor study was supplemented by available clinical cases of superficial neoplasms in humans. One case in particular presented for x-ray therapy over forty skin metastases from an angiosarcoma. This case provided an unusual opportunity to study the differential effects of fine and coarse fractionation upon identical tumors and the skin in the same individual.

The results of this study, in part, supported the hypothesis of Strandqvist's iso-effect curve. The tumoricidal effect, in general, was not altered by the number of x-ray fractions (in all the methods compared) in E 0771 mammary adenocarcinoma, basal cell carcinoma, and metastases from an angiosarcoma. On the other hand, Ehrlich ascites tumor in the solid form, a carcinoma, showed improved tumoricidal effect with very coarse fractionation (two fractions and three fractions) as compared to single treatment dose or fine fractionation.

The normal tissues surrounding the tumors were spared best by the fractional doses administered daily or twice daily. Single doses or doses every other day gave only slightly increased visible normal tissue reaction. Coarse fractionation schedules consistently gave a more severe reaction.

The practical conclusions that can be drawn from this study are that the use of Strandqvist's iso-effect line drawn from therapy of squamous cell carcinoma is valid for use on the tumors studied in this investigation. This is true even though in one type of tumor studied, very coarse fractionation schedules appeared to give superior tumoricidal results, but the normal tissue reaction was so severe that practical use of these schedules would be prohibitive.

Microfilm \$2.00; Xerox \$5.40. 109 pages.

## THE EFFECT OF LOUDNESS RECRUITMENT ON DELAYED SPEECH FEEDBACK

(L. C. Card No. Mic 59-209)

Earl Raymond Harford, Jr., Ph.D.  
Northwestern University, 1958

Supervisor: James S. Jerger

The growth of audiological services for the evaluation of hearing impairment has emphasized the need for more reliable testing techniques for individuals feigning hearing loss. More specifically, there is need for a test which would be relatively simple to interpret and yet provide a reliable, definitive measure of a suspected malingerer's hearing threshold. It has been suggested that delayed speech feedback might prove to be a useful clinical tool to meet this need.

Recommendations for the use of delayed speech feedback as a test to detect malingering have been based on results obtained in persons with normal hearing. Recent research on the phenomenon suggests, however, that individuals with hearing impairment manifesting loudness recruitment may differ from normal-hearing persons in their responses to delayed speech feedback with respect to the sensation level necessary to cause measurable speech disturbance. The existence of such a difference in the behavior of individuals with recruitment would place serious limitations on the discriminatory ability of the test.

The purpose of the present study was to measure the effects of delayed speech feedback in hearing-impaired subjects with and without loudness recruitment. In order to study this problem, the following five groups of subjects were exposed to delayed speech feedback at various sensation levels: (1) a Normal-Hearing Group; (2) a Labyrinthine Hydrops Group; (3) a Masked-Normal-Hearing Group; (4) an Otosclerosis Group; and (5) a Plugged-Normal-Hearing Group. Each group contained ten subjects who were carefully selected on the basis of medical diagnosis and/or audiological tests.

A flashing-numbers testing technique, recently developed by Butler and Galloway, was used to measure the effect of delayed speech feedback. The application of this technique was used in order to motivate the production of speech from the subject, preclude the use of printed reading material, and presumably reduce subject variability. Performance on the delayed speech feedback was expressed as an error-score.

In general, answers to two basic questions were sought: (1) do hearing-impaired individuals with recruitment behave like normal-hearing individuals under comparable conditions of delayed speech feedback; and (2) do hearing-impaired individuals without recruitment behave like normal-hearing individuals under comparable conditions of delayed speech feedback?

The obtained data were submitted to statistical analyses which resulted in the following findings: (1) there were no significant differences in performance on the flashing-numbers test among the five groups of subjects when not exposed to delayed-feedback; (2) there were no significant differences in performance on the delayed speech feedback test among Hydrops, Otosclerosis, and the Masked-Normal groups, nor was there any difference in performance between the Normal and Plugged-Normal groups; but, (3) the Hydrops, Otosclerosis, and Masked-Normal groups showed



significantly greater error-scores than the Normal and Plugged-Normal groups at all sensation levels of delayed speech feedback from 10 through 50 db.

Three outstanding observations emerge from the present study. First, the unusually high median error-scores in the Hydrops and Masked-Normal groups were presumably due to the presence of recruitment. Second, the unexpectedly high error-scores in the Otosclerosis Group apparently were due to reasons other than the recruitment phenomenon, e.g. perhaps an unusual imbalance in the ratio of the delayed and undelayed speech feedback. Third, the delayed speech feedback technique should be valuable for the gross detection of malingering. However, serious restrictions are imposed on its use as a precise predictor of spondee threshold.

Further exploration of various types of hearing-impaired subjects under delayed speech feedback appears warranted. In addition, it may prove highly profitable to investigate the apparent merits of the flashing-numbers technique as a useful tool in the clinical situation.

Microfilm \$2.00; Xerox \$7.00. 147 pages.

## HEALTH SCIENCES, NURSING

### STUDENT PERSONNEL AND GUIDANCE SERVICES IN SCHOOLS OF NURSING

(L. C. Card No. Mic 59-817)

Faith Dorcas Whitmore, Ed.D.  
University of Colorado, 1958

Supervisor: Associate Professor Richard E. Fox

The purpose of this study was (1) to survey student personnel and guidance services in schools of nursing, in the United States, which were fully accredited by the Accrediting Service of the National League for Nursing, as of February, 1955, and (2) to set up, after evaluation of available information, a proposed general plan for organization of guidance services in schools of nursing.

Findings, based primarily on responses of nurse educators to questionnaires and on a review of literature, indicated that outstanding needs centered about problems of staffing, in-service training, budgeting, program planning and coordination, specialized services, placement services, and research.

1. Student personnel and guidance services were coordinated by the director of the school of nursing in 55 per cent of the 126 schools studied and by a designated faculty member in 25 per cent. A need for upgrading qualifications of coordinators for this work was indicated in many schools.

2. In-service programs in student personnel and guidance were available to all staff members in 22 per cent of

the schools, non-available in 27 per cent, and available to guidance personnel only in 12 per cent.

3. Thirty-seven per cent of the schools specifically allocated funds for student personnel and guidance; 57 per cent did not.

4. Contributors to student personnel services other than school of nursing faculty, in 50 per cent or more of the schools were health nurses, social directors, physicians, psychiatrists, ministers, and librarians.

5. Twenty-two per cent of the schools were for and 43 per cent against assuming responsibility for placing students in part-time work. Forty-seven per cent were for and 34 per cent against assuming responsibility for placing graduating nurses.

6. More than one-half of the hospital schools had made studies of curriculum revision in the past five years; more than one-half of the collegiate schools reported studies of academic failures and follow-up of former students.

In view of these findings, the following recommendations are presented:

1. Delegate leadership responsibility for student personnel services to a qualified person, as soon as feasible, chosen on the basis of interest, ability, and qualifications for this work--someone without disciplinary powers or too many other administrative responsibilities. Increase as soon as possible the number of qualified counselors in schools of nursing--full-time or part-time as needs of the schools require. Plan for further education in student personnel at college level for faculty members who function as counselors or advisers to develop more competent leadership supported by specific skills and information.

2. Launch long-range plans for a coordinated program in the school designed to include all student personnel services; identify present practices, gain fundamental facts about student personnel services, analyze resources available to meet the needs, bring into participation all individuals and groups concerned, motivate through in-service education of all staff members, develop and improve standards of service, mobilize financial support, and plan for a sound program of continuous evaluation and improvement.

3. Budget specifically for student personnel services taking into consideration the needs of the school and services already available to students.

4. Initiate long-range plans to improve the number and quality of specialized services available to students.

5. Re-evaluate carefully the need for development or coordination of placement services for students, and cooperate in further development of ANA Professional Counseling and Placement Services at state and local levels.

6. Plan constructively to strengthen ability of nurses and nursing groups to work with and to coordinate contributions of allied professional and community groups. This implies greater mastery of communication skills, of critical thinking and constructive planning, of team work, of understanding significant factors--political, economic, and social--in the environment, and of participating in and interpreting research as a basis for growth and development.

Microfilm \$5.55; Xerox \$19.40. 434 pages.



## HISTORY

### HISTORY, GENERAL

#### THE SOUTHERN BAPTIST SUNDAY SCHOOL BOARD'S PROGRAM OF CHURCH MUSIC

(Publication No. 24,482)

Floyd H. Patterson, Jr., Ph.D.  
George Peabody College for Teachers, 1957

Major Professor: Irving Wolfe

The purpose of this study was to examine the programs of church Music of the Southern Sunday School Board and to give an historical account of its background and development. English and American Baptist past attitudes toward church music were presented and were an integral part of the work. The early attempts of the Sunday School Board toward a church music program were determined as were also the forces and events leading to the establishment of the Church Music Department of the Sunday School Board. An account of the Church Music Department and its developing church music program was made. In addition to considering the organization within the Department, itself, a study was made of its promotional activities, its music publications, and its program of church music education.

The historical method of research was the primary method of procedure. Sources for materials were published books (some on microfilm), articles in periodicals, promotional literature of the Sunday School Board, unpublished "Minutes of the Sunday School Board," *Annals* of the Southern Baptist Convention and of the State Conventions, personal interviews, personal correspondence, and octavo, song book, textbook, periodical and pamphlet publications of the Church Music Department.

#### Findings of the Study

Baptists have moved from the use of little or no music in their worship services to an organized effort to promote a church music program in all Southern Baptist churches. Early attempts by the Sunday School Board to promote church music were scattered and unorganized. Under the leadership of I. E. Reynolds, head of the School of Sacred Music of the Southwestern Baptist Theological Seminary, the establishment of the Church Music Department was effected in 1941. The influence of several activities helped cause the new department. These activities included: (1) the publication by the Board of books and articles by I. E. Reynolds, (2) the publication by the Board of song books and hymnals, (3) the work of B. B. McKinney as Music Editor of the Board, (4) the memorializing of the Southern Baptist Convention and the work of the resulting Committee on Church Music, (5) the attempts of states to develop church music programs, (6) the surveying of Southern Baptist church music in 1939, and (7) the church music emphasis weeks at Ridgecrest Baptist Assembly.

The Department of Church Music was begun with the

aim of magnifying the place of music in public worship. The Department was effective in causing the establishment of a closely knit system of promotion through state, associational and local church departments of church music. It became editorially responsible for the continued publication of hymnals and gospel song books and began the publication of anthems and other graded choir music and materials. Its major music publication was *Baptist Hymnal* (1956).

It developed a series of textbooks for the study of church music and promoted their use through week long classes. This Church Music Training Course was patterned after those of the Sunday School and Training Union Departments. Other educational opportunities were offered by the publication of free pamphlets and *The Church Musician*, Annual Church Music Leadership Conferences, and the study of "Hymns of the Month."

A revision of the Church Music Training Course is in progress (1956). A program of training for graded choirs has been proposed and, with the completion of the revised Church Music Training Course, promises to be the Church Music Department's most significant activity in the field of church music education in the foreseeable future.

Microfilm \$4.70; Xerox \$15.80. 366 pages. Mic 58-5230.

#### CREDIT AND CREDITORS IN THE PHELPS-GORHAM PURCHASE

(L. C. Card No. Mic 59-695)

Robert Warren Silsby, Ph.D.  
Cornell University, 1958

The Phelps-Gorham Purchase of New York State is an area in the western part of the state extending from Lake Ontario to the Pennsylvania border and including much of the Finger Lakes area. Settlement began in the area during the late 1780's and 1790's.

This study attempts to examine the credit needs of the area during the early years of settlement, 1789-1820, and to show how they were met.

The poverty of many settlers and the costs of buying land and beginning farming operations in a frontier community made it a necessity that much buying be done on credit. The problem of marketing crops in an area many miles removed from eastern markets made it extremely difficult to turn crops into cash in order to make purchases or to pay off debts. As a result, anyone who had goods or services to sell found it necessary to devise liberal credit terms if any real volume of sales was to be maintained. Thus the village merchants, druggists and artisans often sold their wares on time, keeping the debts on their books or perhaps accepting notes.

With the vendors of goods offering generous credit terms, the person who had land to sell could do little but



follow suit. By far, the largest percentage of mortgages made during the period were consummated in order to facilitate the sale of land. In a great many cases the mortgage was taken by the seller of the land, often for the full amount of the purchase price. A smaller percentage of indentures were made to allow the borrower to expand his operations, make improvements or pay off his land contract. In general the volume of mortgage credit expanded in time of economic prosperity and declined when times were bad. This was due, no doubt, to the fact that so many mortgages were made as part of a sale of land.

Throughout much of the period, the bulk of credit was supplied by residents of the area. With the exception of four years in the 1790's, when mortgages taken by the Pulteney Associates dominated the picture, no other creditor, either resident or non-resident, held any large percentage of mortgages. The significant fact is that a large amount of mortgage credit was supplied in many small mortgages by numerous individuals who held, at the most, four or five mortgages during a lifetime. The lack of uniformity of terms, suggests that they were often determined by the bargaining ability or reputation of the borrower.

The problem of collecting debts was complicated by the many difficulties faced by the pioneer. The lack of accessible markets, bad growing seasons, sickness, losses of livestock to wild animals were but some of the problems faced by the early settler. Creditors employed various combinations of persuasion, threats and as a last resort, suits or foreclosure. In practice, the latter was used only infrequently. Usually it resulted in the sale of the goods or real property of the debtor at public auction. The shortage of cash in the area meant that personal or real property would usually bring only a small percentage of the debt when sold at auction. Thus, foreclosures were used largely on a selective basis, hoping to pressure other debtors to pay or as a means of securing title to land when it appeared that the debt would never be paid off.

A study of the land selling operations of the Pulteney Associates reveals that even for the large land vendor the problems of formulating credit and collection policies were similar to those faced by smaller creditors.

Microfilm \$3.40; Xerox \$11.60. 262 pages.

## HISTORY, ARCHAEOLOGY

### A STUDY OF THE WOOD AND IVORY CARVINGS FROM GORDION, PHRYGIA (c. 750-500 B. C.)

(L. C. Card No. Mic 59-1004)

Ellen Lucile Kohler, Ph.D.  
Bryn Mawr College, 1958

The University Museum, Philadelphia, has been supporting, since 1950, an archaeological expedition to Gordion, the capital of the ancient Phrygians, on the Central Anatolian Plateau. The questions the excavation seeks to answer are: when and from what direction did the Phrygians enter Anatolia; what was the nature of the development of the separate aspects of their culture; what became of the survivors of the Kimmerian invasion, who lived un-

der the Lydian and Median, and later, under the Persian Empire. Gordion as a large site, with both city mound and burial tumuli, should be able to furnish vital information.

In 1956 Tumulus P was opened and from a tomb of the wooden chamber type, a bronze cauldron full of miniature carved wooden animals was taken. These, dating ca. 725/700 B.C., along with various small carved ivories from the archaic strata on the city mound and from other tumuli dating from ca. 650-500, form the basis of this investigation into the question of the sources of the styles in Phrygian miniaturistic art.

Other schools of carving in wood and ivory during this period are: the North Syrian, Phoenician and Assyrian schools, the "School of the New York Collection," the Ionian Greek school and the Northern Nomadic Animal Style. Other classes of objects, such as pottery, bronzes, terracottas and stone sculpture prove to be valuable comparanda for the period.

The main body of the paper consists of a catalogue of the individual carved wooden and ivory objects from Gordion with detailed comparisons. The sections of the catalogue are in approximately chronological order by the proveniences of the objects, as follows: Tumulus P; the archaic strata on the city mound; Tumuli F, C, D, B and A.

A separate chapter of conclusions was necessary after the Tumulus P section because the wooden carvings fell into four classification with various implications for Phrygian art in the pre-Kimmerian period. These four groups all appeared to point to the east as the direction from which influences came. Group I led through its nomadic and Iranian affinities to the hypothesis that Median art is Group I's closest relative. Group II seems to show the application of local decorative devices upon oriental animal subjects. Group III appears to be related to east Phrygian art, as characterized by finds from the site of Alişar; Group IV appears akin to Nomadic art. All these classes were interrelated and all the objects were probably made at Gordion. A "Phrygian school" with a long tradition behind it can therefore be assumed.

Objects from the archaic strata on the city mound were shown to be connected with North Syrian and nomadic art. Influences upon the carvings from the seventh and sixth century tumuli appeared to be of mixed eastern and western origins, while the objects from Tumuli C, D, B and A showed a break with eastern tradition and a thorough Ionizing in both theme and workmanship.

The final conclusions discuss the implications from these analyses: that pre-Kimmerian Phrygia, so far as miniaturistic carving is concerned, knew only nomadic and oriental art; that late in the seventh century Phrygia came to know Greek art in its East Greek and Mainland forms.

The Assyrian literary sources seem to substantiate the general conclusions.

Microfilm \$2.85; Xerox \$9.80. 220 pages.



OBSERVATIONS ON STYLE AND CHRONOLOGY  
OF SOME ARCHAIC SCULPTURES

(L. C. Card No. Mic 59-1006)

Brunilde Maria Sismondo, Ph.D.  
Bryn Mawr College, 1958

In this thesis, some pieces of Greek Archaic Statuary are re-examined critically in order to construct the most probable interpretation of their chronological and stylistic sequence in the development of Archaic Art. In the course of the investigation the general trend of Archaic Sculpture is seen primarily as a technical effort on the part of the artist to achieve a naturalistic rendering of naked male and draped female figures. In contrast with the stiff, four-sided renderings of the first half of the sixth century, the works dated around 550 B.C. are considered to be influenced by a new tendency (probably coming from the Ionian islands and assisted by the more skillful workmanship of the time) to model rounder forms and produce fleshier figures. Some monuments from the first half of the sixth century (including the Ptoan Head Nat. Mus. n<sup>o</sup>. 15 generally dated a few decades earlier) are contrasted with some kouros and korai belonging to the mid-fifth century. The Moschophoros from the Akropolis is also included in this group, and an attempt is made to lower the traditional dating of the statue. He is furthermore compared with the so-called Lyons kore.

Various maidens from the third quarter of the sixth century are analyzed in the second chapter. Particular attention is paid to the rendering of the drapery and the fashion of the garments. "Antenor's Kore" is discussed at length, as is the philological and chronological evidence to be derived from the inscription on the base. The plastic treatment of her drapery is compared with some dated pieces of sculpture, such as the Siphnian Caryatid and the Athena from the Gigantomachy on the Peisistratid Temple in Athens. The similarity between "Antenor's Kore" and the female figures from the east Pediment of the Alkmaeonid Temple at Delphi is also considered, and a review is made of the information available for the dating of the Delphic Temple.

The third chapter discusses the male figures from the third quarter of the sixth century. The analysis concentrates on the rendering of their anatomy. The Anavysos Kouros in the National Museum in Athens, the Munich Kouros, the "Kouros" from the Alkmaeonid Temple, and several other pieces are examined. The treatment of the nude in the Frieze from the Siphnian Treasury at Delphi is also studied. This analysis leads to a stylistic discussion of the relief. A new arrangement is proposed for the west side.

The fourth chapter deals with sculpture from the last quarter of the sixth century. This is considered the culminating period in the production of the korai, which around 520 B.C. appear extremely elaborate and over-decorative, mostly as a result of increased technical refinement. Toward the closing years of the century, however, the figures acquire a higher degree of femininity, and a tendency toward simplicity begins to assert itself. In the field of male statuary, in addition to the kouros-type we now find seated and draped variants, which are analyzed with the purpose of calling attention to some pieces scarcely known or published in early volumes of periodicals. Among other works, the Dionysos from Ikaria, the seated "Zeus" and the seated "Dionysos" in the National Museum in Athens are studied.

In the fifth chapter the same period is treated with regard to Pedimental and Relief Sculpture. The metopes of the Athenian Treasury in Delphi are examined in detail, and, as a result of this new study, a chronology different from that maintained by the French excavators is suggested.

The sixth and last chapter considers the first three decades of the fifth century. The korai are shown to follow several canons and to have lost some of their vitality. Their drapery undergoes a gradual process of simplification. The products of the decade 480-470 are characterized by an equal emphasis on ridges and valleys in the rendering of drapery: a typical representative of this new style is the statuette of Athena dedicated by Angelitos. The male figures, whose anatomical structure had already been fully grasped by the artists at the end of the previous century, are now used to experiment with principles of ponderation and indications of potential movement. These tendencies lead to the skillfully balanced and articulated figure of the Kritian Boy.

At the end, a brief analysis is given of the figures from the Bediments of the Temple of Athena Aphaia at Aegina. The east gable is contrasted with the west in order to determine the extent of the improvement brought about in the post-archaic period.

Microfilm \$5.70; Xerox \$20.00. 446 pages.

## HISTORY, MEDIEVAL

FROM ELECTION TO CONSECRATION: STUDIES  
ON THE CONSTITUTIONAL STATUS OF AN  
ELECTUS IN THE HIGH MIDDLE AGES  
(VOLUMES ONE AND TWO)

(L. C. Card No. Mic 58-7820)

Robert Louis Benson, Ph.D.  
Princeton University, 1958

Stimulated by the spread of the Church's common law after the publication of Gratian's *Decretum*, the 12th-century canonists formulated a complex but precise conception of ecclesiastical office and election. Master Rufinus (ca. 1157) developed a new, highly influential terminology for different kinds of office: There are, he wrote, offices with "authority" (*auctoritas*), like the episcopal office, and offices of "administration" (*administratio*), a category which included all lesser ranks. By a slight twist which Rufinus applied to these terms, the bishop gains the "power of administering" through his election but achieves the "dignity of authority" only through his later consecration. Rufinus was thus responsible for the first truly sharp distinction between the jurisdictional powers (*potestas iurisdictionis*) and the sacramental powers (*potestas ordinis*) of a prelate. Soon after Rufinus, however, the canonists began to insist that the right to exercise jurisdictional powers derives not from election or consecration but from the election's confirmation by the competent ecclesiastical superior. This new prerequisite to the exercise of official powers was extended to the metropolitans, for whom, as a complicating factor, the older requirement of the *pallium* remained in force. The requirement of electoral confirmation



also constituted an aspect of the Church's program of freedom from lay control, since it was in conflict with the lay rulers' requirement that a prelate must receive regalian investiture before administering his temporalia. By 1300, the meaning of electoral confirmation had been discussed, with substantial differences of opinion, in many works of theoretical jurisprudence, and in numerous decretals it was a subject for papal legislation. In several ways, the new requirement expressed the centralizing tendencies within the Church's hierarchy during the emergence of the "papal system".

There was one exception to the rule: Having no superior, the pope can administer the Roman See with full jurisdictional powers immediately after his election. After the mid-12th century, the canonists defined these papal jurisdictional powers with increasing precision; the new concepts and terminology of office contributed to their definitions. Although in the mid-12th century the term plenitudo potestatis had several meanings, some decretists and early decretalists sought to limit its scope to exclusively papal prerogatives and to regard it as the sum of papal powers. They were thus the first to prepare the idea of papal plenitudo potestatis for its important role in papal political claims and in the consolidation of papal primacy within the Church during the 13th and 14th centuries.

Rufinus' conception of the relations between pope and emperor also rested upon auctoritas and administratio: Considering the emperor a quasi-ecclesiastical official, Rufinus ascribed the higher form of power, auctoritas, to the pope, and the lesser form, administratio, to the emperor. Fusing Rufinus' concept with the notion of the two swords, some later canonists came to regard the emperor merely as the pope's vicar, as his deputy for the Church's temporal affairs, as an official with purely delegated powers. For the curialists of the later 12th and early 13th century, the Rufinan conception of papal auctoritas and imperial administratio provided an answer to the traditional Gelasian dualism of a papal auctoritas and an independent, divinely conferred imperial potestas.

About 1200, some canonists began to apply their electoral theory to the emperor: Drawing the analogy between the emperor and a bishop or lesser cleric, they declared that the emperor could not administer the empire before his election had been confirmed by the pope. Other canonists, however, maintained the analogy between emperor and pope -- for (as they said) each is supreme within his own sphere -- and they asserted the emperor's right to administer immediately after his election, without papal confirmation. Another canonistic position presented the emperor's jurisdiction as derivative, at least in part, from the imperial coronation at Rome. The decretists and early decretalists thus laid a juridical foundation for the struggle over the constitutional status of the German king and emperor-elect, a central issue in papal-imperial relations from the mid-13th to the mid-14th century.

Microfilm \$7.45; Xerox \$26.00. 588 pages.

## HISTORY, MODERN

### WITH THE AMERICAN ARMY INTO MEXICO, 1846-1848

(L. C. Card No. Mic 58-5116)

John Porter Bloom, Ph.D.  
Emory University, 1956

This dissertation is a social history of the United States Army in the Mexican War, with particular emphasis on the rank and file of the volunteers. The author has gathered and related information on every aspect of soldier life, including: food and clothing, hardships and pleasures, duties and pastimes, relations with comrades and with Mexicans, and combat experiences. The chief sources have been the written words of the soldiers themselves, in the form of manuscript and printed letters, diaries, journals, narratives and reminiscences. The volunteer soldiers, as compared to the "regulars," have left a richer body of these materials. The volunteers were also more numerous; hence, the emphasis on them.

The Mexican War provides a unique opportunity for a glimpse of developing American society. Almost a hundred thousand men went into Mexico in the American army. They came from every section of the United States and included many newly-arrived immigrants from Europe. Relatively few of these men were professional soldiers. Their desire to communicate their experiences to family and friends at home, and to posterity, led an unusual number of them to place their thoughts and observations on paper. Thus they left documents which afford much insight into what manner of men they were.

The circumstances of the conflict were unique in American history and important in themselves. This was the first time that an American army carried war into the homeland of a sister republic. The invading Americans not only fought the major battles of the war on foreign soil, but also occupied and provided military government for a very large part of the foreign nation, over an extended period of time.

The present states of New Mexico, Arizona and California were parts of Mexico at the outbreak of war in 1846. This dissertation accompanies the American army, so to speak, into New Mexico but not into the other two jurisdictions. This distinction is made because many of the troops who marched into New Mexico continued their march into the present-day bounds of Mexico, and because New Mexico and New Mexicans were more closely identified with the land and people to the south than were Arizona and California and their inhabitants. Aside from some Indians, Arizona was almost unpopulated. The experiences of American troops in California were unique in so many ways that limitations of time precluded treatment of them in this study.

This study attempts to show that the Mexican War, like other wars, was a curious mixture of the civilized and the primitive. The American troops often distributed largesse freely and generously, and sincerely thought that they could benefit Mexico by eliminating evil rulers and introducing American ways of government and justice. At the same time, American troops were also guilty of very horrible atrocities, as were their enemies. In some instances, notably at Mexico City, American troops observed, and to some degree participated in, a sophisticated, cosmopolitan



society which was quite different from anything that most of them had ever known.

But the outstanding feature of the military experience of most American private soldiers was its extreme hardship. The privations of the soldiers who marched with Scott and Taylor were so great, indeed, as to be almost beyond the conception of American participants in recent conflicts. Microfilm \$4.10; Xerox \$13.80. 320 pages.

#### THE AMERICAN MISSIONARY ASSOCIATION AND THE SOUTHERN NEGRO, 1861-1888

(L. C. Card No. Mic 58-5136)

Richard Bryant Drake, Ph.D.  
Emory University, 1957

With the emancipation of the slaves in 1863 the energies of the former abolitionists were largely directed toward aiding the ex-slaves in their new-found freedom. Of the many societies which ministered to the freedman's need, the American Missionary Association was the most important. Initiated in 1846 as an avenue for slave-free mission moneys, the A.M.A. entered its most important field when it began work among the Southern Negroes in September, 1861. Soon a legion of societies joined the Association in the expanding labor of ministering to the needs of Negroes who fled to the Union armies for protection.

Cleavages which had been present in the abolitionist movement continued in the freedman's aid societies. Most of the abolitionists who followed W. L. Garrison aided the various secular aid societies, and the evangelical abolitionists supported the A.M.A. or the denominational societies which grew up in the late 1860's. At one time the A.M.A. hoped to absorb the support of all evangelical denominations, but with time it became the organ of the Congregational Church.

The United States government played a major role in helping the freedman fit into his new status. The Freedmen's Bureau was the most important, and after the war the only governmental agency for aiding the Negro. The Bureau, under the direction of O. O. Howard, a Congregationalist, worked closely with the established freedmen's aid societies, especially with the A.M.A. The evidence indicates that significant influence was exerted by the A.M.A. upon the policies of the Bureau and upon the selection of the Bureau's personnel.

The mission which the Association envisioned for itself at the close of the Civil War was to carry into the South the basic institutions of the North's free society through work with the Negro. Supported and nurtured by New England and the areas in the Northwest into which New Englanders had moved, the Association recognized the public school and the Congregational Church as the principal institutions that were to train the freedman for his new position. In the process of carrying its "Yankee Burden" into the South, the Association succeeded in giving an important impulse to the development of the public school system in the South; and in establishing many of the important private Negro schools, including Atlanta University, Fisk University and Hampton Institute. Generally speaking, the role that the A.M.A. and the other benevolent societies have played in Negro education has been overlooked

in favor of the less significant work of the Peabody and Slater foundations. The attempt by the Association to plant the New England church among Southern Negroes, however, was generally unsuccessful.

Like the rest of the nation, the A.M.A. was forced in the 1870's and 1880's to take a less hostile attitude toward traditional Southern patterns. While a minority in the Association continued to champion complete Negro equality, financial crisis and a general spirit of sectional good will combined to induce the Association's new leadership to accept a less hostile view toward the South. Furthermore, the Association had developed a vested interest in a friendly, even a segregated South, and accepted the role of preparing Negro teachers in its Negro colleges for work in a segregated public school system.

The principal sources upon which this dissertation was based were the American Missionary, the periodical of the A.M.A. spanning the years from 1846 to 1930; the extensive "American Missionary Association Archives" at Fisk University, which are a vast and largely untapped source of social history for the period from 1846 to 1879; and the highly useful "General Oliver Otis Howard Papers" at Bowdoin College.

Microfilm \$3.95; Xerox \$13.40. 307 pages.

#### POLITICAL NEWSPAPERS OF THE PIEDMONT CAROLINAS IN THE 1850'S

(L. C. Card No. Mic 59-668)

John Calhoun Ellen, Jr., Ph.D.  
University of South Carolina, 1958

Supervisor: William A. Foran

Newspapers constituted the most important local medium for disseminating news, advocating political theories, and reflecting the culture of the piedmont Carolinas in the 1850's. Carolina papers provided readers with an abundance of news, editorials, literary material, and advertising.

The object of this study was to investigate and analyze the important role played by piedmont Carolina political newspapers in the decade before the Civil War. Examination of these newspapers was divided into several general divisions. First, an attempt was made to examine the gazettes as journals. Second, newspapers were studied with particular reference to state and local issues. Third, papers were scrutinized for presentation of national issues. Fourth, a list was compiled of titles and pertinent information relative to individual newspapers. Fifth, a general list was prepared of newspaper files examined in this study.

Foreign and national news were featured by most gazettes, but coverage of state and local news was just beginning to come to the forefront at mid-century. Although Carolina editors varied in ability, they were interested in foreign agitation and strife relative to the Crimean hostilities, Cuba, Hungary, Russian serfdom, and the growth of abolitionism in western European countries. Newspapers devoted most of their national space to the problems evolving around the expansion of slavery in the territories of the United States. On the state and local scene, editors



were usually leaders in the demand for political, social, and economic reform although often in the face of determined opposition by conservative legislators.

Primarily piedmont papers existed for political reasons. Few North Carolina publications were neutral or even independent. They either affiliated with the Democratic party or the parade of political groups which succeeded each other in opposing the Democrats in the 1850's. South Carolina gazettes, printed in a one-party state, often agreed on national matters. However, factionalism developed when immediate secession and allegiance to the national Democratic party were significant issues.

As literary productions, Carolina newspapers treated their readers to a profusion of clipped or locally written fiction, poetry, book reviews, essays, humor, and medicinal aids. In many instances editors encouraged local people to contribute their literary wares, and sometimes editors were forced to write literary material themselves. Local literary offerings plus the ever popular letter-to-the-editor were reflections of local culture not duplicated elsewhere.

Newspaper advertising was a valuable reflector of culture. Advertising offered almost unlimited material depicting an agrarian society based upon the institution of Negro slavery. For example, a survey of advertising revealed useful data concerning miscegenation, prices paid for slaves, occupations, literacy, types of clothing, family life, provisions of masters for slaves, disease, crime, and devotion of the Negro slave to the white man.

Finally, piedmont Carolina newspapers experienced notable growth and development in the 1850's. Growth occurred both in the number of publications and in the total circulation while mechanical improvements and competition fostered the production of more interesting and readable formats.

Carolina newspapers of the 1850's compared favorably with their twentieth century counterparts. Ante-bellum gazettes kept their readers better informed upon national and foreign affairs than any but the largest dailies of the 1950's; placed more emphasis upon quality of news carried; gave more extensive coverage of debates, treaties, political proceedings, speeches, documents, and verbatim reports of laws than today's weeklies, semi-weeklies, and small dailies. Only in the presentation of local news are the twentieth century Carolina gazettes superior to their fore-runners.

Editorially, present-day newspapers lack the personal touch and editorial importance exhibited by editorial writers of the 1850's. Readers knew where their favorite editor stood on nearly every issue. Editorials were locally written and were not produced by syndicates.

Piedmont Carolina newspapers were the reflectors of culture and public opinion. More adequately than any other medium they reflected the culture, thoughts, and desires of upcountry Carolinians of the 1850's.

Microfilm \$4.75; Xerox \$15.80. 369 pages.

## THE CLOSER UNION MOVEMENT IN THE BRITISH WEST INDIES

(L. C. Card No. Mic 59-877)

Norman Ross Fertig, Ph.D.

University of Southern California, 1958

Chairman: Professor T. Walter Wallbank

In the spring of 1958 the West Indies Federation came into being. This new nation, which aspires to dominion status within five years, has been the goal of West Indian leaders since 1922. As a result of the Royal West India Commission Report by Lord Moyne, made in 1939, the official policy of the British Government was to encourage this development. The intervention of the Second World War delayed progress on federation until the dispatch of a note by Colonel Oliver Stanley in 1945 to the unit legislatures, requesting that they initiate debate on the subject and plan for an early conference to offer recommendations.

In 1947 at Montego Bay, Jamaica, plans were made for the creation of a Standing Closer Association Committee, which was charged with formulating a basis of federation. Subsequent conferences in London in 1953 and 1956, together with West Indian conferences on particulars of the federal structure and federal responsibilities, led to the union of the island colonies in a single federation in January of 1958.

The West Indian Federation and the closer union movement which preceded it represent a maturation of British colonial philosophy. In achieving this success the initiative was British, and the timing, form, and final decisions wholly West Indian. Keeping pace with progress toward union was the growth of representative and responsible government in the individual colonies. In this instance the British Colonial Office did not move with consistence and equality in each colony. Some colonies had representative and responsible government as well as universal adult suffrage many years before these same privileges were enjoyed by other colonies. This dilemma of unequal political evolution was one of many problems which had to be resolved before federation could be effected.

The factors which operated against formation of the Federation, and which will affect its future, include considerable geographic dispersion, a racial complexity, insularity of thought and action, poverty, disproportionate shares of the resources in the West Indies, and singularly large populations in some colonies. To be added to this list is a further factor, the hostility of some Latin-American states toward the inclusion of British Guiana and British Honduras in the Federation. These two colonies did not join, but for other reasons.

Centrifugal tendencies were finally overcome by the stronger forces which moved in favor of federation. The strength of these bonds was derived from a common culture and common institutions, all British in origin. The strength of these forces has been of sufficient power to prevent the emergence of any important West Indian nationalist sentiment. A further bond was found in the aspirations of West Indian political leaders who realized that political autonomy, economic progress, and prestige status could be achieved only by merging small units into a single political body.

The final effort has been directed toward the achievement of a status which gives to the Federation continuing



aid — financial, advisory, and technical — from the United Kingdom; and which, at the same time, gives to the people of the British West Indies political control of their future.

The final result has been the achievement by the West Indian colonies of a flexible arrangement which reserves to the British Crown for a period of five years control of foreign relations, defense, and the maintenance of public order. In 1963, if the West Indies Federation has proved successful, it will take its place as a sovereign state within the Commonwealth.

Microfilm \$4.15; Xerox \$14.00. 324 pages.

#### A HISTORY OF THE NEGRO WAGE EARNER IN GEORGIA, 1890-1940

(L. C. Card No. Mic 58-5143)

Edward Aaron Gaston, Jr., Ph.D.  
Emory University, 1957

This thesis seeks to fill a portion of the gap in the post-Civil War history of the Negroes of Georgia by studying in detail the Negro wage earner in the state from 1890 to 1940. Through the use of available numerical data an effort is made to discover the major fields of Negro employment, trends of employment in these areas, and to find to what extent Negroes entered into new forms of employment with the passage of time.

The data revealed that among the four general occupational classes which included the greatest number of Negro wage earners, only among the basic industries was there a decline in the proportion of Negroes to all Negroes who worked. The proportion in the domestic and personal services remained virtually the same, while in the category of trade and transportation and that of manufacturing and mechanical occupations the trend was upward. Increases in these fields of employment took place at the expense of employment in the basic industries, particularly in agriculture.

At all times agriculture employed more of Georgia's Negroes than any other industry. Yet a decrease in the proportion engaged in agriculture was under way in 1890, and after World War I the decrease in the proportion was rapid. During the half century, among Negroes operating farms, those owning farms varied from 10% to 20% and non-owners from 80% to 90%. Slight decreases in the proportion of Negro non-owner operators to all Negro operators were shown in the agricultural census reports of 1935 and 1940. A decline in their actual numbers had started by 1920. The number of non-operating Negro farm laborers increased for each census period from 1890 through 1910 and decreased thereafter.

Next to agriculture the domestic and personal services were the most important forms of occupations for Negroes as to numbers employed. Prior to 1920 little change occurred in the proportion of Negroes—roughly 30%—engaged in these occupations. In 1920 some decrease in the proportion took place, but by 1930 the proportion returned almost to its usual level but declined slightly during the next decade. Negroes were losing out to white competition in some personal service occupations such as barber, hairdresser, waiter and waitress.

Trade and transportation was always an important

source of employment to Negroes, varying from 5% to 9% within the half century. As Georgia became increasingly urbanized a larger proportion of Negroes found employment as deliverymen and as porters and helpers in stores. In local hauling, even when motor driven vehicles displaced animal drawn, large numbers were employed. Steam railroads always furnished large numbers of Negroes with work, particularly as laborers.

The statistical data for this study were largely drawn from the federal census reports and from reports of various divisions of the federal and state governments. Studies by private groups and individuals contained statistical materials, usually for specific industries or areas. Numerous tables in the thesis consolidate the statistical data to reveal the major trends.

Most of the jobs held by Negroes, even those in the building industries and in manufacturing plants, fell into the unskilled categories. Only a few had skilled occupations. There is no way of objectively measuring the forces and influences, such as organized white opposition and the color line, which prevented Negroes from entering skilled and semi-skilled occupations in larger numbers. Nevertheless, an effort is made through the use of materials from contemporary newspapers, magazines, travel accounts, public records, surveys, and other sources to offer some explanation for the employment patterns presented by the statistical data.

Microfilm \$6.90; Xerox \$24.20. 542 pages.

#### THE IMPERIAL FEDERATION MOVEMENT IN CANADA, 1884-1902

(L. C. Card No. Mic 59-146)

Guy Robertson MacLean, Ph.D.  
Duke University, 1958

Supervisor: W. B. Hamilton

This dissertation analyzes the Imperial Federation movement in Canada during the years from 1884 to 1902, through a study of its formal institutions, the Imperial Federation League and the British Empire Leagues, and of reaction in Canada to their policies.

The Imperial Federation League in Canada was misnamed in that its members aimed at a federation of the British Empire only in a limited sense. Most of the leaders of the movement turned down at one time or another the many published plans for a federal constitution with a central Parliament in London, preferring to see instead a gradual evolution of closer unity through the co-operation of the Mother Country and colonies on matters of trade and defence, the improvement of inter-communication, and the fostering of general understanding among the peoples of the Empire. The main concern of the Canadian branch of the Imperial Federation League was a system of trade preferences within the Empire designed to increase the sale of colonial goods in the markets of the United Kingdom. Participation in Imperial defence, one of the chief aims of the League in Britain, was played down by the Canadians.

The League's strength lay in the province of Ontario, mainly among the English element, and many of its leaders



were drawn from the United Empire Loyalists or the Loyal Orange Order, the extreme Protestant organization. Its adherents never numbered more than two thousand members, but many of its members obviously were of above-average social importance in their communities. The movement was weakest in the province of Quebec where it attracted the support of only one prominent French-Canadian, Israel Tarte.

The League was never formally connected with any one party but it exerted a considerable influence on whichever party happened to be in power. Generally, more Conservative politicians than Liberal belonged to the League, but neither party cared to alienate those groups which supported the League.

A variety of motives, in addition to loyalty to the Mother Country, may be traced in the support which the League received. For example, Canadian Pacific Railway interests were heavily represented in the main committees of the League, and this railway was described as a great contribution to Imperial unity, especially when the financial assistance of the Government was desired. Others in the League desired closer co-operation with Britain on military matters, being painfully conscious of Canada's relative military weakness as the neighbour of a major power. Fear and dislike of the United States seemed to move many of the imperialists. The League's activities languished in Canada until 1887 when a strong agitation for reciprocal trade agreements with the United States led to a violent reaction among those who thought that such a policy would lead to political absorption by the Republic and caused many, especially in Ontario to take an active part in the Imperial Federation League which they had previously ignored. Further, some federationists were animated by prejudice against the French Catholics.

The research has been based chiefly on primary sources: newspapers, numerous collections of private papers, and literature published by the Imperial Federation and British Empire Leagues.

Microfilm \$5.40; Xerox \$19.00. 423 pages.

#### THE HUMANITARIANS AND POST-CIVIL WAR INDIAN POLICY

(L. C. Card No. Mic 59-801)

Robert Winston Mardock, Ph.D.  
University of Colorado, 1958

Supervisor: Professor Robert G. Athearn

The Civil War and the immediate postwar years witnessed a general deterioration of government-Indian relations. Agency corruption, treaty-violations, and the rapid expansion of settlement resulted in numerous Indian wars and a national problem: how to prevent the threatened extermination of the red race and, at the same time, avoid barriers to westward migration. With the publication of a Congressional report in January, 1868, revealing the deplorable status of the western tribes, humanitarians demanded reform. The entry of Lydia Maria Child, Wendell Phillips, Peter Cooper, and other antislavery humanitarians into the Indian rights movement marked a transition of reform energies from freedmen's rights to the rights of the red race.

The influence of the humanitarians on the reform of Indian policy cannot be measured with preciseness. However, when their demands and proposals are compared with the actual changes that were incorporated in the government's program over the years, the similarity is too striking to be merely coincidental. Beginning with the United States Indian Commissioner in 1868, Congress and top government officials were periodically bombarded with petitions and memorials, and interviewed by delegations, so that humanitarian influence was both direct and persistent.

The humanitarian approach was dominated by a humanistic-Christian concept of racial equality and the brotherhood of man; by a sense of guilt for past national wrongs, and a moral responsibility to right those wrongs; by an optimistic faith in mankind's innate capacity for improvement; and, finally, by a conviction that military force was inimical to freedom and progress. However, the fact that humanitarian concepts were often based upon inadequate understanding of the Indian problem, together with a reluctance to recognize the Frontier and military side of the question, aggravated hostility to the reform cause, making it more difficult to formulate and maintain a consistent Indian policy. On the other hand, the resulting controversies created a national awareness of the Indian problem.

A humane policy, based on education, Christianization, and civilization, with the agencies under church control, was promoted by the reformers (the Quakers were outstanding proponents) and inaugurated by President Grant in 1869. Its objectives were to bring about peaceful co-existence, or even assimilation into white society, and thus prevent extermination. Though western spokesmen condemned the humane approach as sentimental and unrealistic, there was little legislation or activity concerning Indian policy after 1869, that did not bear the imprint of humanitarian ideas and demands.

The reformers made the Grant peace policy a campaign issue in 1872, secured the removal of several corrupt or non-cooperative Indian Bureau officials, and staunchly opposed transfer of Indian affairs to the War Department. Their successful demands for clemency for convicted Indian leaders and assurances of aid to visiting Indian delegations helped to secure some Indian cooperation with reform efforts. Humanitarian support prevented a collapse of the peace policy following the Modoc massacre (1873), and saw it through the critical years from 1876-1879.

In 1879, humanitarian opposition to forcible Indian removal to reservations brought a resurgence of reform zeal and a new phase of the humane program, marked by efficient reform organization, mass propaganda, and closer government, humanitarian, and western cooperation. The peace policy was shorn of its church affiliation and greater emphasis was placed on individual land ownership and citizenship as roads to civilization. These objectives were embodied in the Dawes Severalty Act (1887), the culmination of two decades of humanitarian-reform endeavor. By this time it seemed apparent that the red race would not be exterminated, that peaceful Indian-white relations were near attainment, and that the humanitarian objectives of justice, equality, education, Christianization, and citizenship had been partially realized. But in the final analysis, it was primarily the influence of humanitarian concepts that guided American Nineteenth Century idealism and reform into a crusade for the rights of racial minorities.

Microfilm \$4.70; Xerox \$15.80. 367 pages.



**THE PARLEMENT OF PARIS, THE FRENCH  
CROWN, AND ROYAL ABSOLUTISM  
DURING THE FRONDE, 1643-1652**

(L. C. Card No. Mic 58-7016)

Alanson Lloyd Moote, Ph.D.  
University of Minnesota, 1958

The conflict between the Parlement and the crown during the Fronde is discussed as a crisis in the evolution of monarchical government in France before 1789. Both published and manuscript sources are used, and historical interpretations of the Fronde are outlined.

The monarchy, theoretically absolute, in practice retained only overall control of state policies and the sole right to legislate. Normal judicial and administrative functions were delegated to "ordinary officers", and through purchase of offices and the privilege of bequeathing them, the officers secured an all but permanent control over their functions. The officers belonging to the Parlement and other sovereign law courts held in addition the de facto right of judicial review over legislation. The constant struggle between the dual authorities of the state, crown and officers, to dominate governing functions resulted in a delicate balance of power. Gradually the crown, its royal councils, and their agents, particularly the embryonic intendants, encroached on the officers' functions. By 1643 the monarchy was threatening to overthrow the balance of power.

The Parlement as the leading body of the officer group resisted this tendency during Louis XIV's minority when the crown was weakened by foreign wars, financial difficulties and the willingness of the regent and the prime minister to bargain with rather than intimidate the officers. By 1648 the Parlement won substantial victories in legislation by continually blocking fiscal laws. It also reduced royal encroachments on its judicial and administrative functions. Early in 1648 the regency counter-attacked. The king's personal absolute will was used to forbid parliamentary attacks on legislation. The officers' right to bequeath their positions was also threatened. However, the Parlement now challenged the king's will, and all of the sovereign law courts combined in opposition to the threat to their right of bequeathing their positions. In July, 1648, the regency allowed representatives of the courts to draft reforms for the kingdom.

The reforms restored the balance of power. The officers' judicial and administrative functions were protected by law against conciliar attack, and the intendants were abolished. The sovereign courts' right to review fiscal legislation was recognized by law. They also placed limits on royal credit policies.

From 1649 to 1652 the Parlement resisted the crown's attempt to overthrow the reforms; in 1649 the Parlement even took up arms in self defence against a royal blockade of Paris. Nevertheless, the Parlement refused to convert the defensive war into an offensive one, and assumed few illegal powers in attacking the crown. It denied that it was a rebellious or revolutionary body. Later it refused to join the nobles in revolt against the crown. After defeating the nobles in 1652, the crown gradually revoked many of the reforms and by the 1660's dominated the officer group. However, the officers and especially the Parlement remained a thorn in the side of the monarchy to the end of the old regime in 1789.

Microfilm \$4.75; Xerox \$16.00. 371 pages.

**BRITISH COMMERCIAL RELATIONS WITH  
CENTRAL AMERICA 1821-1851**

(L. C. Card No. Mic 59-657)

Robert Arthur Naylor, Ph.D.  
Tulane University, 1958

Supervisor: William J. Griffith

Historians generally indicate that from the time of Central American independence in 1821 until the signing of the Clayton-Bulwer Treaty with the United States in 1850, Great Britain enjoyed a dominant position among foreign powers in Central America. Nevertheless, they have made little attempt either to determine the nature and extent of British activities in Central America or to explain the objectives and motivating factors behind British policy in terms of economic self-interest.

The present study is intended to contribute to a fuller understanding of the importance of foreign influences on early Central American national development by an examination of trade with Great Britain as one of the economic forces which affected the independent Central American states during their formative years. Official commercial relations between Great Britain and Central America are discussed with particular reference to the controversial career of the British consul, Frederick Chatfield. Tariff policies, the monetary system, communications, and transportation facilities are described in considering the conditions under which the commerce was conducted. The products involved in the trade, and the relationship to the Central American commercial organization of British companies and merchants particularly in Central America and Belize, as well as in Great Britain, Jamaica, Peru, and Chile, are examined in investigating the nature of the trade. Commercial statistics are analyzed in detail in order to determine the channels through which the Anglo-Central American trade flowed, the extent of the trade, and the relative significance of that trade to Great Britain and Central America.

The study is based primarily upon materials located in the British Public Records Office, the British Museum, and the Central American holdings of Tulane University, but relevant documents in the National Archives in Washington were utilized also. Particularly indispensable among the manuscripts in the British archives were the Foreign Office Series relating to Central America, the Colonial Office Series on Belize, and the Customs and Excise Ledgers, from which the commercial statistics were compiled.

The thesis is that for the first thirty years of Central American independence the predominant interest and principal influence of Great Britain in the Central American states were commercial. Great Britain occupied the preponderant position in the foreign trade of Central America and her supremacy in that realm brought as a by-product an ascendancy in Central American affairs that enabled her, until 1849, to follow a unilateral policy despite the fact that she neither recognized the independence of the Central American Republic nor established diplomatic relations with any of the five Central American states. The dominance of Great Britain in the foreign commerce of Central America until mid-century was more the result of British pre-eminence in international trade, manufacturing, and finance than of any concerted action on the part either of the British government or of British companies.

Microfilm \$4.85; Xerox \$16.20. 380 pages.



**THE LOWER SHENANDOAH VALLEY DURING  
THE CIVIL WAR: THE IMPACT OF WAR UPON  
THE CIVILIAN POPULATION AND  
UPON CIVIL INSTITUTIONS**

(L. C. Card No. Mic 59-56)

Edward H. Phillips, Ph.D.  
The University of North Carolina, 1958

Supervisor: Fletcher M. Green

Between 1861 and 1865 the lower Shenandoah Valley experienced all the vicissitudes which a location on the border during a struggle which underwent radical changes in character could impose. The outbreak of war disrupted the intimate social and economic relationships between the lower Valley and the Northeast which the Baltimore and Ohio Railroad had fostered during the three decades preceding. The war-born prosperity of small industries and large purchases of produce by Confederate armies partially offset the disadvantages of the severance of old economic ties. Invasion in 1862, however, destroyed the new southern economic orientation of the region. During subsequent brief periods of occupation by Confederate armies only a very limited reintegration of the region with the remainder of the Confederacy was possible. The federals, when in control, held the region as conquered enemy territory and permitted it only a small regulated commerce with the North.

From the beginning war affected all aspects of institutional life, some disastrously. Public schools closed for the duration of war. Local government falteringly assumed new duties while suffering a growing paralysis in the exercise of traditional functions. The military steadily encroached upon civil government in the handling of disaffected persons and suspects, in nearly all matters of police.

Invasion speeded up the process of disorganization. In the spring of 1862 civil government disintegrated. All banks and insurance companies closed or moved into the interior. Public utility corporations became dormant or expired. Private schools closed and, except for a few one-teacher elementary schools, remained closed. Local newspapers, published with increasing difficulties after the summer of 1861, expired. The institution of slavery began its slow dissolution. Except those congregations which had been rent by partisan bitternesses, churches revealed a greater capacity to resist the disintegrative effects of war.

Meanwhile the Valley suffered large losses of property which were incidental to combat, to the use and destruction of property by armies, and to the depredations of soldiers. The tendency of war in their midst was to reduce the people of the lower Valley to an ever lower standard of living, but it did not threaten to make life impossible for an agricultural people as long as armies observed the traditional restraints. Gradually, however, northern commanders came to the conclusion that an effective system of warfare would require not merely waging war upon armies but also upon the enemy population which made it possible for enemy armies to remain in the field. As applied by General Philip H. Sheridan in the Valley the new system embraced devastation of the countryside, the large-scale arrest of males, and even the use of terror. Sheridan's system was effective. It took the Valley out of the war by destroying its ability to sustain Confederate armies and by destroying, among the people, any lingering confidence in prospects for ultimate Confederate victory.

In the preparation of the work the author relied primarily upon collections of letters, diaries, governmental records, and other institutional records, many of them unpublished. The Flowers Collection, Duke University, and the Southern Historical Collection, University of North Carolina, were particularly helpful. The manuscript records in the Virginia State Library and in the National Archives were also of notable value.

Microfilm \$5.65; Xerox \$20.00. 442 pages.

**THE LIFE OF ASLE J. GRONNA:  
A SELF-MADE MAN OF THE PRAIRIES**

(L. C. Card No. Mic 58-7425)

William Weiland Phillips, Ph.D.  
University of Missouri, 1958

Supervisor: James L. Bugg, Jr.

This study represents an attempt to recreate the private and public life of Asle Jorgenson Gronna, with a special emphasis upon his relationship and contributions to the Progressive Movement on both the national and state levels.

He was a man of many talents which were expressed in almost perfect conformance with the stereotyped American outline for success. Personal independence coupled with self-gained prosperity, according to the formula, were necessary prerequisites to marriage and fatherhood. Political fame, if forthcoming at all, usually followed these attainments. Gronna's career unraveled part by part according to this master outline. In a plains setting he acted out the familiar story of the self-made man, becoming the leading merchant and farmer in his North Dakota community. In 1883, having attained a measure of financial achievement, he married. He gained affluence and won economic independence in the following two decades. Finally, he served his state for sixteen years in Congress, from 1905 to 1911 as a Representative and from 1911 to 1921 as a Senator.

He belonged to the great middle class and developed with it. A rugged individualist in early manhood, he matured into the very personification of progressivism during the House battles over the issues of Cannonism, the Payne-Aldrich Tariff and the Ballinger-Pinchot affair, and the struggle against reactionary bossism in North Dakota. But, as with America as a whole, so with Gronna—the change was deliberate. Until about 1906 he lagged behind current progressive ideas more often than he stood in the forefront of the fight for their realization. The great expectations that the settling of Dakota and that his own successes had engendered within him were dashed with disillusionment by the maldistribution of wealth, power and opportunity brought by industrialism. Hope was revived in Gronna, as in the nation as a whole, with the belief that, through the medium of political reform, America could be socially, economically and politically retooled into the highly desirable state its romantic literature made it out to be.

Gronna's Senatorial career, up to 1917, was not particularly distinguished. He fought President William Howard Taft's proposal to affect a tariff reciprocity arrangement with Canada, leading the Senate opposition to the idea.



He compiled a creditable, progressive voting record on the New Freedom, even though opposing the Underwood Tariff and the Clayton Anti-Trust Act.

In 1917 he gained his greatest fame when, as one of only six Senators, he voted against America's entry into World War I. It was his most notorious moment as a public figure, and brought upon him the nation's wrath. The press unleashed an avalanche of abuse and derision without parallel in the country's history. Efforts to expel him from the Senate were unsuccessful, but for the duration of the war he was pilloried as an obstructionist, traitor, communist, and Kaiserite.

Actually his voting record upon war measures was commendable, and in general he supported Wilson's program. But his stature was enhanced more by his protestations against certain items in that program than by his approval of the larger part of it. In the area in which the administration gave its saddest performance, namely, the protection of civil rights, Gronna steadfastly held to the principle that victory had to be won without intruding upon basic human liberties.

His public career was brought to a close in the primary election of 1920, when faulty political foresight and personal enmities got him at cross purposes with the Nonpartisan League, the most powerful political force in North Dakota at that time.

Microfilm \$9.35; Xerox \$33.20. 738 pages.

#### THE ROLE OF COMMUNISM DURING THE MUNICH REVOLUTIONARY PERIOD, NOVEMBER, 1918-MAY, 1919

(L. C. Card No. Mic 59-562)

John Raatjes, Ph.D.  
University of Illinois, 1958

The role of Communism in the German revolution of 1918-19 has been described almost exclusively in terms of the events in Berlin. Bavarian Communism during this period, however, posed an even greater threat to the newly-formed German Republic, for had Communism succeeded in establishing itself in Bavaria it might well have become a vital link in the spread of Communism moving from the Soviet Union to western Europe through the south.

This study centers its attention on the origins, the activities and the rise to power on April 13, 1919, of the Munich branch of the German Communist Party. It traces the movement back to that segment of the Eisner opposition group which, after the Eisner revolution on November 7, 1918, broke with him to form the local branch of the Spartakusbund. It describes the movement's early lack of theoretical foundations and its tenuous connection with the Central Committee of the Communist Party in Berlin.

Only in March 1919, with the arrival of Eugen Levine and other northern Communists, did the local movement receive theoretical guidance and its first effective organization. Having taken only the first steps in the direction of forming an effective political party, the local Communists were offered leadership of the revolution on April 13, 1919. Despite admonitions by the Berlin Central Committee to the contrary, the local Communist group felt compelled to assume leadership. Their only chance for success in Ba-

varia lay in the hope that possible uprisings elsewhere in Germany and Austria would swing Bavarian opinion to support of the revolution. Such uprisings failed to take place. The inability of the Communists to organize effective resistance against the opposing forces of the Free Corps brought their short period of leadership to an end.

In spite of frequent assertions that Communism in Munich was the product of non-Bavarians and Jews, this study indicates that Communism in Bavaria was firmly rooted in Bavarian soil. However, the Communist rise to leadership of the revolution on April 13, 1919, must be attributed to the inability of the traditional Bavarian party leadership to guide Bavarian affairs. The Bavarian Communists did not so much "make" a revolution as inherit it.

Microfilm \$3.60; Xerox \$12.20. 277 pages.

#### COERCION AND FREEDOM IN A WAR SITUATION: A CRITICAL ANALYSIS OF MINNESOTA CULTURE DURING WORLD WAR ONE

(L. C. Card No. Mic 59-1316)

Willis H. Raff, Ph.D.  
University of Minnesota, 1957

Advisers: Mary Turpie and Mulford Sibley

Almost irresistible pressures toward conformity on the part of all civilians seems characteristic of modern warfare; these pressures were particularly powerful within Minnesota during World War One. Unsupported by deeply ingrained traditions of freedom, there was little recalcitrant individualists could do but suffer, or be silent, when confronted by blatant intimidation from social and political leaders. Socialists, IWW's, Pacifists, and Nonpartisan Leaguers were opposed, in Minnesota, by a coalition of Republican-Democrats, the Commission of Public Safety, and all who might lose valuable perquisites if radical reforms were accomplished. This coalition of the concerned, led by the Commission, can be called representative of a business-industrial urban civilization advancing inexorably at the expense of a persistent agrarian society. Thus, the clash between the League - embodiment of the older agrarian resentments - and the Commission was bound to be violent; a special ingredient of bitterness was added to the contest because the unstable regional attitudes did not yet include the respect for nonconformity that is more typical of societies farther removed from the roughness of frontier materialisms.

Dominated by Judge John McGee, enthusiastic militarist who blackened the reputations of many honorable men, the Commission sought to mold the minds of all Minnesotans to conform to its own nationalistic oversimplifications. The emotionally super-charged accusation of disloyalty was used to justify violent measures against the farmers' League, to justify the banning of many political gatherings throughout the state. Self-appointed "law and order" groups eagerly assisted the campaign of coercion by conducting many tarring and feathering parties, mobbings, lynchings and deportations. On the Commission's initiative, the rough arm of coercion was used to sweep suspected professors from their positions, municipal officials were removed from office, a lawyer was dis-barred,



respected legal procedures prostituted to promote bond sales. The Courts gave executive powers to the Commission that had been denied originally by the Legislature; thenceforth it exercised powers in ways that proved the extreme danger of delegating governmental powers to narrow men who see in unorthodox thought the imminent destruction of society.

Self-conscious individuality was hounded out of existence; the man-in-the-street was not immune to the "reign of terror" either. Failing to purchase his "allotments" of bonds, he might be subpoenaed to a hearing and jailed and fined for contempt; he might fall into a huge "slacker raid" dragnet in which grown men played war games to round up draft dodgers; his newspapers attempted to teach him a frightful imagery of the Hun-Kaiser; self-appointed patriotic operatives snoop into his private life and financial affairs; if he was Swedish or German, his nationality was stigmatized as traitorous by Judge McGee testifying before a Congressional Committee.

Because group adjustment had come to replace individual leadership as the guiding ideal of education even before 1917, educational leaders were quite prepared for the mobilization of schools; they were mobilized so thoroughly that those Minnesota teachers even suspected of harboring ambiguous ideas about the war were summarily dismissed no matter how impressive their reputations.

Perhaps it was the absence of a strong faith in the traditions of freedom in the upper midwest that enabled civic leaders to crudely coerce people of independent thought. Articulate nonconformity withered before the hot breath of war and the economic and political beneficiaries of an industrial, as opposed to an agrarian society. It was not without good cause that Professor Ernest S. Osgood once said of this era in Minnesota: "It Has Happened Here!"

Microfilm \$3.95; Xerox \$13.40. 308 pages.

#### THE ROLE OF THE STATE LEGISLATURES IN THE CONFEDERACY

(L. C. Card No. Mic 58-5175)

May Spencer Ringold, Ph.D.  
Emory University, 1956

The preamble of the Confederate Constitution adopted on March 11, 1861, emphasized the "sovereign and independent character" of the Confederate states. Constitutional provisions for taxation failed to include "general welfare" and thus made it, by implication, a state function. Such a scheme broadened gubernatorial and legislative responsibilities. This study concentrates on efforts of legislatures to avert or relieve crises at home and to maintain, as nearly as possible, normal social, economic and political institutions.

Hostile Indians on western frontiers, long and inadequately defended boundaries and the possibility of slave revolt confirmed the determination of state leaders to provide protection through regular armies, volunteer units and reactivated militia. Local defense systems reduced Confederate man-power resources and caused friction between state and Confederate officials. Other issues arose to becloud Confederate-state relations. Suspension of the writ of habeas corpus to enforce conscription evoked legis-

lative disapproval and grave misgivings arose over mismanagement and inefficiency in government agencies.

State governments showed initiative and courage in attempts to relieve economic dislocation attendant upon war and invasion. Laws protected banks from withdrawals of specie reserves and permitted them unwonted extension of bank-notes. Several states curtailed cotton production and to conserve food all limited distillation of grain. Some states took over production of salt and whiskey. As scarcity of manufactured goods became acute, legislatures entered into manufacturing and trading. State agents purchased goods abroad and at home; and penitentiaries became production centers for cotton and woollen cards, leather goods and textiles. General assemblies encouraged railroad expansion through loans and subsidies. The abandonment of *laissez-faire* had little precedent and success of state measures was restricted by administrative weaknesses.

Although defense measures, Confederate policies and economic stability received primary consideration, governors and legislators endeavored to maintain social and political institutions. Control of labor, preservation of order and operation of government required additional restraint and adaptation of civil procedures to emergency conditions in exposed areas. Lawlessness persisted; but governmental machinery continued to function. Even school systems survived the crisis of war.

State authorities, directly or indirectly, sustained soldier and civilian morale. They provided, when possible, clothes and blankets for men in the field. State laws relieved soldiers from taxation and from forced sales of property for debts. In some cases, soldiers were permitted to vote *in absentia*. Aid to sick and wounded soldiers was generous if not systematic; and expressions of gratitude were frequent and effusive. Morale was sorely tried by the extortionate business practices prevalent in the South. Legislatures failed to apply effective regulation and instead instituted dole systems to assist victims of war and speculation. The state governments took over from counties the task of financing relief; but relief all too frequently was impeded by incompetency or dishonesty.

Legislatures had difficulty in financing state activities. As the market for states' bonds contracted with receding chances of Confederate victory, a trend developed toward wholesale issuance of state treasury notes. A few states raised taxes; but the effects were to a degree nullified by moratoriums on collections. Ultimately, prices became exorbitant; treasury notes and bonds greatly depreciated in value; and taxes were difficult to collect. Waning of Southern resistance was further evidenced by numerous desertions, trading with the enemy and demands for peace and reconstruction.

The Confederacy entered war with little preparation. State governments rushed into the breach left by a withdrawal of Northern money, credit and goods. They squared shoulders under burdensome responsibilities. But a pervading weakness sapped at the foundations of society. Without money, credit and industrial productivity, Southern states could set the house in order but they could not prevent its collapse. In the words of Professor Charles W. Ramsdell, "There was not time."

Microfilm \$3.25; Xerox \$11.20. 251 pages.



# ANTEMURALES CHRISTIANITATIS: THE AUSTRIAN MILITARY BORDER IN CROATIA, 1522-1749

(L. C. Card No. Mic 59-569)

Gunther Erich Rothenberg, Ph.D.  
University of Illinois, 1958

The subject of this thesis is the early history of that special military institution, the Military Border (*Militär-grenze*), which the Austrian authorities maintained in Croatia from 1522 to 1881. The author has made an attempt to provide a narrative account of this institution from its establishment under Ferdinand I in the early 16th Century to its reorganization under Maria Theresa in the middle decades of the 18th Century. At the same time, he has attempted to link the story with the wider developments in the Habsburg empire and in Southeastern Europe.

During these years, when the Ottoman power posed a constant threat to Christendom and the Turkish horse-tail standards appeared twice before the gates of Vienna, the Military Border served a dual purpose. Its inhabitants, recruited from the hardy and war-like Greek Orthodox Christian refugees fleeing the Turkish occupied areas of the Balkans, were given special privileges by the Habsburg emperors and in turn were liable to perform continuous military service, both as frontier guards and as troops in the service of the dynasty. Freed by imperial decrees from the usual manorial obligations, these settlers, referred to as *Grenzer*, served not only as a defensive screen against the frequent Turkish raids, but also as a brake on the Separatist ambitions of the powerful local Hungarian and Croatian nobility, continually restive under the emerging centralism of the Habsburg dynasty.

Isolated by religion, national origin, and special status from the socio-political currents of the era, the *Grenzer* developed a fierce pride in the military status as well as an intense loyalty towards the dynasty, perhaps the only genuine patriotism which that family was able to evoke in its vast possessions. However, the loyalty of the *Grenzer* too often was taken for granted and the imperial court in Vienna did not hesitate to sacrifice the just demands of the Border to the aspirations of the Hungarian and Croatian magnates, or to the greed of the local estates, whenever such a course was deemed expedient. Indeed, out of the conflicting and confused picture of rivalries, self-centered ambitions, and nationalist aspirations, only the often ill-used *Grenzer* appear to emerge with much credit.

Quite naturally, the role of the Military Border has been pictured in many different versions, usually dependent on the national bias of the particular writer. Special arguments and pleading have always provided much of the stock in trade for historians of the Balkans. The author, however, has attempted to steer a neutral course between the Austrian, the Croatian, the Hungarian, and the Serbian interpretation. Instead he has based his account mainly upon the primary sources - diaries, reports, memoranda, and other documents, provided by the Kriegersarchiv Wien, the Austrian Staatsarchiv, as well as published materials from the archives of the Vatican and the deposits in Croatia. In addition, the author has sifted through the vast mass of the more commonly known secondary materials.

The account makes no claim to be definitive, but wishes merely to serve as an introduction to an aspect of European history which, in the United States at least, has received less than its due attention.

Microfilm \$2.90; Xerox \$10.00. 222 pages.

# POLITICS AND ADMINISTRATION IN THE AMERICAN COLONIAL COLLEGES

(L. C. Card No. Mic 59-586)

Althea Lucille Stoeckel, Ph.D.  
University of Illinois, 1958

The colonial college was not a unifying force in American intellectual life; it was regional in outlook and denominational in background. By the end of the eighteenth century American statesmen were looking beyond the colonial college for a different kind of institution to meet the needs of an expanding nation. Yet the basic pattern of the colonial college persisted as the American institution for higher learning until after the Civil War. In the period before the American Revolution nine colleges based on this pattern were founded from New England to Virginia. They were Harvard (1636) in Massachusetts; the College of William and Mary (1693) in Virginia; Yale (1701) in Connecticut; the College of New Jersey (1746), now Princeton University; King's College (1754) in New York, the present Columbia University; the College of Philadelphia (1755), now the University of Pennsylvania; the College of Rhode Island (1764), now Brown University; Queen's College (1766) in New Jersey, the present Rutgers University; Dartmouth College (1769) in New Hampshire.

The colonial college was easily reproduced: its organization was simple, its teaching staff small, its purpose limited. In every area where the needs of society were basically those of a frontier area the college was adequate. It attempted to provide, with the means at its disposal, a liberal education that would introduce youth to the thought and literature of the past, discipline his mind, form his character, and prepare him for leadership in business, government, and the church.

All of the colleges except the College of Philadelphia were affiliated with a religious denomination, but they were not dedicated to the training of the clergy, and the youth of all sects were welcome. No college charter required youth to subscribe to a religious creed.

From 1750 to 1800 a number of plans were discussed that were designed to educate larger numbers of citizens on a broadened vocational and professional basis and to make the state responsible for higher education. The place of religion in education, and the political and religious control of the colleges were most hotly debated issues. Jealousies of religious groups and ambitions of political factions were closely interwoven with a sincere desire for stable colleges.

The system of academic government developed in the colonial college has remained, with little modification, to the present time. Between the trustees, who had the legal right, but seldom the time or the ability and interest, to govern the college, and the instructors whose responsibility was the training of students, the office of college president was erected. One of the primary problems in founding and maintaining the early colleges was to secure a satisfactory president who could teach, if necessary, but above all able to advise the trustees in major policy decisions. A college acquires life and individuality through the men who have been responsible for it, and the character of many of the colonial colleges was determined by their presidents.

In a system dominated by the personality of the president there was little place for the development of faculties. As each college grew in size and financial stability, however,



men began to appear who did more than listen to the daily recitations of students. These first college professors were conscious of certain rights, privileges, and responsibilities in an academic environment.

This study traces the development of the colonial college from its beginning in 1636 to the American Revolution, the changes brought to some schools by the American Revolution, and the development of a system of college administration. Microfilm \$2.30; Xerox \$8.20. 176 pages.

#### ARTHUR PLANTAGENET, VISCOUNT LISLE AND THE ADMINISTRATION OF CALAIS, 1533-1540

(L. C. Card No. Mic 59-592)

David Asher Waas, Ph.D.  
University of Illinois, 1958

Calais was England's first colonial experiment. It was Edward III's design to repopulate the town and make it truly a piece of England across the sea. From his reign until 1558 it remained a treasured possession though during the final fifty years its actual value to England steadily declined. With the increased activity of the Merchant Adventurers the power and prosperity of the Staple declined making it unable to maintain its share of the costs of maintaining and defending the town at the same time those costs were rising. The ancient defenses were increasingly obsolete and in constant need of repair. The population had become less English and more Continental and in the final years French influence in the town and pale was marked.

Declining prosperity and English power were accompanied by a confused religious situation. The Protestant reformation and the separation of the English church from papal allegiance brought intense religious controversy to the town which found extremists of every type eager to preach in its streets and churches.

In the midst of this crucial transitional period Arthur Plantagenet, Viscount Lisle was appointed deputy of the town and pale. The natural son of Edward IV, Lord Lisle was the uncle of King Henry VIII, and yet was harmless as a rival for the throne. Because of this he was able to rise to one of the most eminent positions of the realm. He spent the early years of his life in obscurity but the death of Henry VII allowed him to take his place at court where he received increasing favors from Henry VIII. Lord Lisle's fortunate marriages brought him land and additional prestige, but more, his second marriage brought him a wife of powerful character and will who felt it her duty to inject stamina into her husband's spine, by force if necessary. The energetic, forceful, and ambitious Honor, Lady Lisle, became one of the dominant factors in Lord Lisle's life and career. She played an important part in his rise to prominence but at the same time her tastes in things material and in religion were largely responsible for placing his credit in jeopardy and eventually cost him his liberty and life.

The Lisle administration dated from 1533 to 1540 coinciding almost exactly with the years in which Thomas Cromwell exerted great power in the government, and in which England made far reaching religious decisions. In 1540 lord Lisle was suspected of having correspondence with his cousin Cardinal Pole. He was removed from of-

fice, sent to the Tower, and all his papers were seized. As a result of this seizure a magnificent collection containing thousands of items of correspondence, business transactions, and official documents was preserved. Published in the Letters and Papers of Henry VIII, the Lisle papers provide not only a good account of a significant historical figure, but an opportunity to examine the government of Calais under Tudor rule.

Although he was hesitant, had poor judgment of men, and was dominated by a more capable wife, Lord Lisle was not a bad deputy. He was crippled by the cumbersome machinery of Tudor government and by officials who did not understand the needs of the town. He served conscientiously and under severe handicaps but made at least two important contributions, one in bringing together the ordinances of the town and the other in modernizing the defenses. Knight of the Garter, vice-Admiral of the royal navy, lord deputy of Calais, Arthur, Viscount Lisle was the last of a line, a belated Plantagenet.

Microfilm \$3.95; Xerox \$13.40. 308 pages.

#### CHURCHES IN THE CONFEDERACY

(L. C. Card No. Mic 58-5190)

Willard Eugene Wight, Ph.D.  
Emory University, 1958

"Churches in the Confederacy" is a study of the work of the churches, not a study of religion. Principal sources are the manuscript and printed minutes of the church bodies, records of congregations, writings of the clergy and the church press. The study includes major denominations of the South: Methodist, Baptist, Presbyterian and Protestant Episcopal. The minor sects: Lutherans, Catholics, Quakers and Jews are treated as material permitted.

Major attention is given to the part played by the churches, through clergymen and other agencies in the secession crisis and in support of the Confederate cause. Special emphasis is given the work of the churches on the home front, in the army, among the Negroes and in education.

In the secession crisis the clergymen's role closely paralleled the politicians'. Both ranged from Unionists to Confederate fanatics, with a heavy preponderance on the Southern side. The ministers used their influence to aid the secession cause, led their churches and church assemblies to support the Confederacy, worked ardently for its cause. Loyalty of each to his state, plus a sincere belief that God favored the South, led the majority of those in the seceding states to become ardent supporters of the Confederacy.

In the Confederate States of America none did more than the churches to further the Southern cause. Preachers of all denominations identified this cause with that of Divine Providence. They opposed any idea of compromise or surrender, frequently assuring their members that God was on the Southern side.

The churches spent much effort both in raising and sustaining morale on the home front and in sending soldiers to war with the blessings and consolation of the church. They supported President Davis and his administration wholeheartedly.



The people at home showed a vital interest in religion in the first two years of the war. Defeat, speculation, and lack of material necessities led to war weariness and spiritual decline the last two years. The clergy themselves exhibited no loss of interest. Despite inadequate salaries they strove to maintain the peacetime work of the churches.

During the early years of the war soldiers felt the conflict would be short; hence, most of them regarded life as free of restraint. With scant and poorly organized services the churches were of little help in correcting this attitude. By the last two years of the war the churches learned to help so successfully that revivals and conversions swept the Southern armies.

Clergymen went to war as chaplains for inadequate com-

pensation. Missionaries, who were generally more acceptable to the soldiers than chaplains, were also sent to the army. Colporteurs distributed Bibles, tracts and religious literature to service men. Few soldiers indulged in sin without having its pitfalls pointed out by one of the church agencies.

In its attitude toward the Negro the church showed very little change during the war. Clergymen defended slavery as a divine institution, exhorted the Negroes to be good, obedient servants. Revivals were held among the slaves with good results. Genuine efforts, initiated and led by the clergy, were made to remedy some abuses of slavery. Churchmen did not hesitate to attribute the peaceful relations between black and white to the influence of religion.

Microfilm \$3.15; Xerox \$10.80. 242 pages.

## HOME ECONOMICS

# USE OF TIME BY MARRIED HOMEMAKERS IN THE TEACHING FORCE, MANILA, PHILIPPINES

(L. C. Card No. Mic 59-686)

Delfina Salvador Maceda, Ph.D.  
Cornell University, 1958

Chairman: Marjorie Knoll

This study was undertaken to: (1) provide data on time spent in homemaking activities by married homemakers in Manila, Philippines who are assuming the responsibility of a professional position along with homemaking, (2) determine the effect of size of household and stage of family life cycle on time expenditures for homemaking, and (3) determine the kind and amount of help given by members of the household in homemaking tasks.

The data were obtained through a questionnaire filled out by 150 married homemakers in the teaching force, Manila, Philippines. Homemakers reported their use of time on two week days. All homemakers recorded their time expenditures on Saturday and groups of 33 each recorded for one of the week days, Monday through Friday.

The homemakers averaged a total work day of 12.2 hours on regular school days and 10.1 hours on Saturday. The time for homemaking increased from 5.6 hours on regular school days to 8.1 on Saturday. The most time consuming task for the homemakers was food preparation. To supplant the tasks of the home, 23 per cent of the homemakers used a commercial laundry and all patronized the bakery. The homemakers liked cooking, care of the house, care of the family members, and home decorating best. Dishwashing and washing clothes were disliked most.

Husbands, relatives, children, and paid helpers helped the homemakers in homemaking tasks. The helpers averaged 18.9 hours a day on regular school days and 11.8 hours on Saturday in their household duties. Paid helpers did most of the household duties and their most time consuming task was care of the family members.

When homemakers' and helpers' time expenditures for

homemaking were combined the mean hours was 24.5 on regular school days and 19.9 on Saturday.

Although the activities of the home are much the same, many problems seem to have more potency in a given stage of the family life cycle or with changes in size of household. As families increased in size and age of the family members as they moved through successive stages of the family life cycle, increases in homemakers' mean time expenditures ranged from 1.6 to 2 hours for food preparation, 0.9 to 1.3 hours for care of the house, and 0.7 to 1.2 hours for sewing and mending clothes. There was a decrease in mean time spent from 4.1 to 1.5 hours for care of the family members. The stage of the family life cycle did not affect the time spent for marketing.

As the size of the household increased, the mean time spent by the homemakers increased from 0.7 to 1.6 hours for sewing and mending clothes. Conversely, decreases from 2.7 to 1.6 hours for care of family members and 1.5 to 0.1 hours for ironing clothes were noted. The size of the household did not affect the homemakers' time expenditure for other tasks studied.

The helpers' mean time spent for sewing and mending clothes increased from 1.2 to 2.3 hours as the size of the household increased, while the mean time spent for care of the family members decreased from 5.1 to 4.2 hours.

When homemakers' and helpers' time expenditures were combined, increases were found from 3.9 to 4.5 hours for care of the house and from 2.5 to 4.1 hours for ironing clothes. The mean hours spent for care of the family decreased from 7.8 to 6.1 as the size of the household increased.

The electric polisher and vacuum cleaner were found to be helpful labor saving devices for the homemakers who owned these pieces of equipment spent a mean time of 0.9 hours while those who did not own them spent 1.5 hours for care of the house.

The family life cycle and size of household as factors for analyzing homemaking time expenditures open ways to understand problems and potentials of family life.

Microfilm \$2.40; Xerox \$8.40. 183 pages.



## JOURNALISM

### THE MARSHALL PLAN INFORMATION PROGRAM IN WESTERN EUROPE AS AN INSTRUMENT OF UNITED STATES FOREIGN POLICY, 1948-1952

(L. C. Card No. Mic 59-1312)

Alex S. Edelstein, Ph.D.  
University of Minnesota, 1958

From 1948 to 1952 the United States carried on the largest peacetime foreign aid program in its history. Intended to preserve the free political institutions of Western Europe against the threat of Communist expansion, the Marshall Plan was viewed as a major segment of United States foreign policy.

At the insistence of a Congress hostile to the Democratic administration and to the State Department, a new agency was created to administer the European Recovery Program (ERP). That agency, the Economic Cooperation Administration (ECA), established its own information program to support its extensive economic activities. It worked in the field with the United States Information Service, utilizing its facilities and, in turn, providing it with information.

#### The Marshall Plan information program was unique in many ways:

It was brought about by congressional initiative; it was expanded on the basis of congressional demands, and it was merged with the United States Information Agency in 1953 with the support of Congress.

The Marshall Plan information program for a time filled the information "vacuum" created in Western Europe by postwar "entrenchment" in overseas information activities. It was characterized by an "action" approach, particularly in the person-to-person labor information program; its media program was extensive, highly diversified, and unusual, involving the use of such special devices as showboats, troubadours, balloons, and other techniques.

Agreements with ERP nations required them to carry on their own publicity programs in support of Marshall Plan objectives. Great Britain mounted an impressive program of popular economic education. The Organization for European Economic Cooperation (OEEC) carried on publicity activities in behalf of all the participating countries.

Counterpart funds provided the major source of funds for the ECA information program. Media guarantees provided encouragement to the expansion of United States media activities in Western Europe.

A special information unit in the Office of the Special Representative, Paris, carried on the European program in support of the economic and political objectives of the ERP. Information offices were established in each mission to carry on country programs. Special effort was directed toward such goals as increased industrial and agricultural productivity and toward European economic inte-

gration. The information division in Paris provided news to an ECA information division in Washington to inform the American people on progress toward ERP goals.

#### The Marshall Plan information program provided important lessons for future overseas information activities:

ECA information officers worked with their "opposite numbers" in country information ministries, training them in publicity techniques, and themselves learning the importance of fitting information content to national cultures.

The "operator's program" demonstrated the need for explicitly defined information objectives and clear lines of authority to the field in spelling out policy. Top-flight media personnel proved their value.

Support was afforded for the concept of an independent information agency through the generally successful degree of cooperation achieved between the USIS and the ECA information teams.

#### There were also some problems and inconsistencies in the Marshall Plan information program:

The theme of European economic integration suffered from confused objectives, changing programs, and an ambiguity of terms.

Protective economic provisions of the ECA afforded the Soviet Union easy propaganda targets at which the Cominform (specially created to defeat the Marshall Plan) could aim.

The "second information agency" created some duplication and competition.

The aggressive operations of some press-agentry minded media operators embarrassed the United States and foreign nations.

#### The Marshall Plan information program proceeded in three stages:

The first stage was the period of press agentry; the second was a period of closer support for economic objectives; the third stage saw the ECA merge into defense-support activities resulting from the intensified Cold War and the outbreak of the Korean conflict. The ECA information program phased into the Mutual Security Agency information program in 1952. On August 1, 1953, all major information programs were combined in the USIA.

The Marshall Plan information program demonstrated that the best program of persuasion is one generated by a truly effective instrument of national policy. The ERP was such an instrument.

Microfilm \$5.95; Xerox \$20.80. 468 pages.



THE INFLUENCE OF  
CONSUMER-PRODUCT TESTING  
AND REPORTING SERVICES ON  
CONSUMER BUYING BEHAVIOR

(L. C. Card No. Mic 59-570)

Hugh Williams Sargent, Ph.D.  
University of Illinois, 1958

The purpose of this study was to measure the influence of the brand ratings and recommendations of the two consumer-product testing and rating services--Consumers Research, Inc., and Consumers Union, Inc.--on selected durable and non-durable good purchases of households which subscribe to or consult their reports. The behavior of the report-reading households in making purchase decisions, and their opinions about the efficacy of the reports, were studied in conjunction with certain socio-economic characteristics.

As background attention was focused on the new "mass middle market," characterized by a desire for expertness in consumption, which developed following World War II. Also documented is the accelerated interest in consumer behavior. Special notice is taken of the interdisciplinary character of recent consumer studies utilizing the methods and insights of the behavioral sciences in conjunction with traditional marketing analysis.

The research design of this thesis, likewise, is cross-disciplinary in the sense that it queried households about their buying behavior in order to determine the effect of a kind of mass communication (consumer reporting publications). The basic strategy was to find out what brands of selected durable and non-durable goods the sample households had purchased in the two years preceding the study and then to compare these brands with those recommended in the monthly and cumulative reports in Consumers Research Bulletin and Consumer Reports.

The sample consisted of an approximately equal number of households which refer to the reports for buying advice and those which do not, drawn, randomly, from six

Midwestern states, subscribers located through publication circulation lists, consultants and non-subscribers from telephone directories.

It was assumed that subscribing and consulting households would be guided by the published ratings of branded products, as evidenced by the fact they had purchased more of the recommended brands than had the non-consulting households. It was also assumed that reader-households would adhere more closely to the recommendations for durable than for non-durable goods, since more "problem-solving," as contrasted with "habitual," behavior is involved in the former. Since the disposition to seek market information requires a fairly high intelligence, it was assumed that report-reading households would indulge in more information seeking than would non-consulting households. In view of their greater amount of investigation prior to purchasing, it was assumed that referring households would have heads who had, on the average, achieved higher educational levels, incomes, and occupational status, and were younger, as a group, than those of non-referring households. It was also assumed that report-reading households would be favorably disposed toward the publications as evidenced by frequency with which they used them, length of time a subscriber, and statements made about the helpfulness, reliability, and shortcomings of the reports.

The findings revealed that the publication-referring households are guided by the reports, the consultants about the same as the subscribers. Also, these households seemed to be more influenced in major than in minor purchases. The referring households are better-educated, have higher incomes, are younger and presumably have higher occupational status than non-referring households. In comparing the audiences of the two publications they were found to be about the same in their buying behavior and socio-economic characteristics, Consumers Research readers showing slightly higher incomes and average age. Both audiences are favorably disposed to the publications (Consumer Reports readers slightly more so), and both make selective and objective use of the reports, on the whole. Microfilm \$3.55; Xerox \$12.00. 273 pages.



## LANGUAGE AND LITERATURE

### LANGUAGE AND LITERATURE, GENERAL

#### MATTHEW ARNOLD AND THE ROMANTICS

(L. C. Card No. Mic 58-5419)

Leon Albert Gottfried, Ph.D.  
University of Illinois, 1958

Matthew Arnold is a central figure in Victorian letters not only because of his importance in his own time, but also as a twofold transitional figure, interpreting earlier literature to his age and linking his age to ours through his insight into the disruptive forces of modern life. In particular, he is an important bridge between us and the great Romantic poets, for if, as a poet, he reacted vigorously against them in some ways, he was deeply influenced by them in others. Moreover, it is as an interpreter of the Romantics that he has exerted some of his greatest critical influence. Hence a detailed examination of his relations with the Romantics can help define his special position and accomplishment. The present study proposes to analyze this complex of literary relationships. Its primary focus is upon Arnold himself; the influence of other Victorians on him and his influence on later critics are mentioned only in passing, when at all, since other scholars have already treated these subjects. Especially close attention is paid to Arnold's poetry, but his critical, social, and religious thought are also considered where relevant.

The introductory chapter, after briefly surveying the principal scholarship in the field, delineates generally the place of the Romantics in Arnold's literary purview. Subsequent chapters take up, respectively, Wordsworth, Byron, Keats, and Shelley and Coleridge. A number of whole poems and many passages are analyzed in an effort to understand the nature and extent of Romantic influence upon Arnold and his reactions to this influence. In addition, all his literary criticism, miscellaneous prose writings, correspondence, and notebooks have been studied for evidence which would shed further light upon both his consciously held opinions and his less consciously formed attitudes toward these poets and other subjects where Romanticism (or anti-Romanticism) played a significant part. Although my main purpose has been to analyze and understand, I have not hesitated to criticize and evaluate Arnold's poetry, his opinions, and his methods. In a few instances where such subjects have not been covered by other scholars, factual matters which are tangential to my central purpose are also dealt with. For example, a tentative solution is offered, based upon all the available evidence, of the puzzling question of Arnold's reading in Coleridge's prose works.

Although for convenience the material has been divided by poets and subdivided in various ways, an effort has been made to maintain an organic approach by keeping aware of interrelationships between Arnold's prose and his poetry, between his early and late work, between his general and specific opinions, and in short by remembering that although Arnold's work covers a lengthy time span and is

extremely varied, it is after all the work of one man. The concluding chapter, rather than being a summary, essays a synthetic and exploratory discussion of Arnold's general relations with Romanticism. After continuing from the first chapter the discussion of the place of the Romantics in the poetic tradition as Arnold saw it, the analysis proceeds to consider Arnold's own ambivalent attitude toward Romanticism. Particular emphasis is laid upon two points: the limitations imposed upon Arnold's revolt against Romanticism by its influence upon him, and the decline of faith in the imagination which tended to vitiate his high claims for the function of poetry. Finally, Arnold's appraisal of the Romantics is evaluated. Although his particular opinions may be criticized, his closeness to the Romantics, combined with his regretful sense of their deficiency as props against the rigors of modern life, give his judgment of the movement poignance and continued relevance. Microfilm \$5.15; Xerox \$18.20. 401 pages.

#### CHAPTERS TOWARD A STUDY OF CHAUCE'S KNOWLEDGE OF GEOGRAPHY

(L. C. Card No. Mic 59-880)

John Atlee Hertz, Ph.D.  
Lehigh University, 1958

This dissertation, begun as a study of all aspects of Chaucer's geography, was eventually limited to source relationships of geographical matters, Chaucer's cosmography, and various excursions into geographical matters not concerned with sources or cosmography. Areas which have not been covered are the biographical aspects of the problem and certain portions of the works. These will be treated in my subsequent pursuit of the whole subject of Chaucer's geography.

Chaucer makes more frequent use of geography than do most of his contemporaries. In the thirteen Canterbury Tales for which complete analogues exist, although the average tale is 3.1 times as long as the average of the corresponding analogue(s), Chaucer uses 4.2 times as many geographical names. Moreover, whereas in the analogues nearly all geographical names are used for routine purposes of topographical and directional identification, half of Chaucer's are found in literary allusions, figures of speech, references to articles of commerce, and the like. The analogues have a total of three such items; Chaucer has seventy-three. Chaucer likewise exhibits a broader range of geography than fellow fourteenth-century writers, half again as many different geographical names as in Gower and five times as many as in Piers Plowman. He uses less, however, than his classical sources.

Particularly in Troilus and Criseyde and the Knight's Tale, Chaucer makes artistic use of geographical tags and metaphors not found in his sources to add depth and



development to plot and characterization and to fit the teller and the tale. Against the virtue of improving upon his sources must be weighed the twenty-three geographical errors he makes. One to which attention has not previously been drawn is in the Knight's Tale, where, contrary to his sources and to historical fact, Chaucer locates the Athenian Temple of Clemency outside the city, between Athens and the harbor.

In the chapter on cosmography, after a discussion of the poet's concept of the universe, especially as exhibited in the Parliament of Fowls, I examine pertinent works of authors named by Chaucer who could have given him his ideas of cosmography. In approximate chronological order these authorities are Aristotle, Vergil, Ovid, Seneca, Ptolemy, St. Basil, St. Augustine, Martianus Capella, Macrobius, Cassiodorus, Boethius, Isidore of Seville, Vincent of Beauvais, and Dante. Probably the most influential was Macrobius' Commentary on the "Dream of Scipio," to which he refers in the early part of the Parliament. Not to be ignored, however, are Ovid's Metamorphoses, the Satyricon of Martianus Capella, the Speculum Naturale of Vincent, and Dante's Divine Comedy. The cosmographical content of Boethius' Consolation of Philosophy is slight, and of Ptolemy's great treatises Chaucer knew only the Syntaxis Megale ("Almagest"), a work on astrology containing incidental references to cosmography. No direct connection between Chaucer and the cosmographical writings of the other eight writers can be demonstrated. As examples of widely read contemporary works on cosmography possibly known to Chaucer but not mentioned by him I also discuss briefly the de Sphaera of Sacrobosco and Mandeville's Travels.

Among other items touched on are suggested origins of the medieval distinction between "Ilion" and "Troye," the Prussian shield borne by certain warriors in the Knight's Tale, the multiple confusion in the minds of Chaucer and other writers as to what places were sacred to the Muses, what the term "Ermonye" (Armenia) may have meant to Chaucer, and further evidence to support the probable connection between the Legend of Cleopatra and Vincent's Speculum Historiale.

Microfilm \$4.90; Xerox \$16.40. 383 pages.

#### THE DRAMATIC CAREER OF ROBERT BROWNING: A SURVEY AND ANALYSIS

(L. C. Card No. Mic 59-145)

Charles E. Johnson, Jr., Ph.D.  
Duke University, 1958

Supervisor: Lionel Stevenson

This study is a survey of Robert Browning's dramatic career from the publication and performance of Strafford in 1837 to the publication of Luria and A Soul's Tragedy in 1846. Of the seven plays he wrote all but the last two were intended for the stage, although only three, Strafford, A Blot in the 'Scutcheon, and Colombe's Birthday, were performed during this period and shortly afterwards. Two of his plays--King Victor and King Charles and The Return of the Druses--were rejected by William Charles Ma-cready, with whom Browning worked at the beginning of

his career. By using contemporary documents such as the letters of Browning and his friends, the memoirs and diaries of those who were in close contact with the poet, and the newspaper reviews of the individual plays, one gets a view of both Browning's efforts to write successful plays for the stage and of the reception of his work. This view affords one conclusion: Browning worked diligently with experienced theatrical people, but he was unable to present a successful drama in the conventional sense, or even a play which met with popular success.

An analysis of the plays reveals that Browning's basic interest as a poet precluded successful drama, for his interests were not in the objective representation of character and event in such a way as to reveal the development of character, but rather he presented in his plays a study of character under the strain of incident or event solely to analyze the conditions of the soul in relation to event. Although some of the plays do make obvious concessions to popular histrionic methods, notably in their use of melodrama and pathos, they are essentially character studies in the guise of plays. The analysis of each play shows that Browning was interested in presenting "the incidents in the development of soul" and not in the continuous development itself and that in spite of his willingness to compromise with many requirements of conventional drama, he never achieved that necessary balance between ideas and character on the one hand and action, the objective embodiment of both, on the other hand.

Furthermore, the plays reveal that from 1837 Browning worked more and more independently of conventional stage concerns and gave vent to his natural interest in characters. During this time, after experiment with the form in plays like King Victor and King Charles, Colombe's Birthday, and in Pippa Passes, he also became interested in the short poem as a vehicle for character revelation. He evolved the dramatic monologue as a form congenial to his talents with the publication of Dramatic Lyrics in 1842. The plays, however, contain many examples which approach the dramatic monologue, and although these long speeches adversely affect the dramatic quality of the plays, they were a testing ground for Browning's development. Therefore, a careful analysis of Browning's plays shows that, although they were failures from the standpoint of successful conventional drama, they are very important documents in his development.

Microfilm \$3.60; Xerox \$12.20. 277 pages.

#### THE VISUAL AND THE VISIONARY IN THE WORK OF JAMES FENIMORE COOPER

(L. C. Card No. Mic 58-7420)

Manly Johnson, Ph.D.  
University of Minnesota, 1957

The pictorial quality of Cooper's writing is often noted but seldom analyzed to show how it is and is not painterly. Cooper was heir to the eighteenth century interest in visual experience, out of which developed the picturesque tradition, combining a propensity for analytical observation with moral fervor. An analysis of his nature descriptions places Cooper in the picturesque tradition; but he augments the painterly qualities of his descriptions by exploiting the



temporal dimension of narrative writing, so that far from being non-functional embellishments, his descriptions of nature are integral with theme and structure in the novels. His "pictures" are seldom without a purpose; they promote the theme, further the plot, aid in characterization, provide satiric contrast, and often skilfully blend two or more of these functions.

The didacticism of Cooper's writing is also often noted but never analyzed in the context of his whole system of thought. He used the novel as a philosophical vehicle, the framework of a nostalgic and diverting romantic plot supporting the cosmology of a devout and active intelligence. He viewed history as the struggle of man to earn reconciliation with God. Thus the mode of his didacticism is prophetic. Part of his message is, "Repent or perish!" But he was more than a prophet crying doom; his belief in the Christian covenant made him an apostle preaching salvation in parables. He felt that truth was too severe for most men and must come disguised as divertissement. The pictorial qualities of his writing illustrate his characteristic transition from seeing to knowing, from sight to insight. In fiction, Cooper saw a glass dark enough for looking at truth.

Microfilm \$2.30; Xerox \$8.20. 176 pages.

#### A COMPARATIVE STUDY OF THE SIZE AND NATURE OF READING AND LISTENING VOCABULARIES

(L. C. Card No. Mic 59-1314)

Stanley Benjamin Kegler, Ph.D.  
University of Minnesota, 1958

The purpose of this study was to compare the size and nature of reading and listening vocabularies of 211 secondary school students in Grades VIII, X, and XII. The measure used consisted of 147 multiple-choice items based on 87 systematically-chosen entries from the Thorndike-Barnhart Comprehensive Desk Dictionary: 24 of these items were specifically designed to test variant senses of four of the 87 basic entries.

Variant, but equivalent, forms of the measure were presented orally and visually to produce listening and reading scores. The order of items and method of administration were alternated.

Results of the tests were analyzed to determine the extent to which sex, grade level, intelligence, and reading ability influence the size and depth of meaning of reading and listening vocabularies. The Revised Stanford-Binet (Form L) was used as the criterion of intelligence; the median percentile rank on three sub-tests of reading ability in the Iowa Tests of Educational Development battery was used as the criterion of reading ability in Grades X and XII; the Test of Silent Reading Comprehension of the Iowa Every-Pupil Tests was used as the criterion of reading ability in Grade VIII.

Two methods of analysis of variance were used--equal-frequencies and unequal-frequencies or unweighted means analyses. A total of 810 variance ratios, or "F" tests, was calculated. The "least squares" method was employed as a check on the results of the approximate methods and no significant differences were noted.

The following results were noted:

1. Size of reading and listening vocabularies is closely associated with grade level, intelligence, and reading ability.
2. Size of reading and listening vocabularies is unrelated to sex.
3. Students (especially boys) who are poor readers are likely to have larger listening than reading vocabularies.
4. Depth of meaning in reading vocabularies is closely associated with grade level, intelligence, and reading ability; depth of meaning in listening vocabularies is closely associated with intelligence and reading ability.
5. Depth of meaning in reading vocabularies is associated to some extent with sex; depth of meaning in listening vocabularies is quite unrelated to grade level or sex.
6. There is some slight evidence that boys have greater depth of meaning in listening than in reading vocabularies.
7. There is considerable evidence that boys have greater depth of meaning in reading vocabularies than girls; there is some slight evidence that this is true of listening vocabularies also.
8. Wide ranges of scores exist in both reading and listening vocabularies in the grades tested; the overlap among the three grades was very great, with students from each grade scoring at the extremes of the ranges for each of the other grades.

Several interesting questions are raised in this investigation. It would be of interest to know the reasons for the lack of sex differences in size of reading and listening vocabularies when sex differences seem to influence the knowledge of variant meanings (depth of meaning) in reading vocabularies especially, and in listening vocabularies.

A second problem of some importance deals with the matter of grade level being relatively unrelated to depth of meaning in listening vocabularies.

Lastly, the extent to which intelligence is a basic causal factor in reading and listening vocabularies and in reading and listening ability is a problem needing further examination.

Microfilm \$3.55; Xerox \$12.00. 274 pages.

#### MILTON'S EIKONOKLASTES: AN ANNOTATED EDITION

(L. C. Card No. Mic 59-544)

Sonia Miller, Ph.D.  
University of Illinois, 1958

John Milton's Eikonoklastes is the best known of a series of seventeenth-century books occasioned by the publication of the run-away best-seller, the Eikon Basilike. On February 9, 1649, ten days after the beheading of King Charles I, appeared the so-called "King's Book," entitled



Eikon Basilike: The True Portraiture of His Sacred Majestie in his Solitudes and Sufferings... MDCXLVIII. Not only the usual book-buying public, but thousands of people whose library consisted of one book, a family Bible, rushed to buy the Eikon; for the execution of the king was an act deplored by all Englishmen (Episcopalians, Presbyterians, and Roman Catholics) except the Army partisans, the Independents, and some of the sectaries. Even in the last-named groups there were men whose stern determination to remove the king from the throne either boggled at the manner of his trial or stopped short of desiring his execution.

Later in the summer occurred the publication of an anonymous tract called Eikon Alethine, the first answer to the Eikon Basilike. The author refuted the so-called "King's Book" chapter by chapter and denied throughout that it was the work of the king, insisting that the writer was a "doctor" among Charles's chaplains. An anonymous Royalist then countered with Eikon Episte... in vindication of Eikon Basilike, in answer to an insolent Book, Intituled Eikon Alethine, 1649.

Milton's Eikonoklastes, a small quarto of 242 pages, was a fuller answer to Eikon Basilike than the slender Eikon Alethine. It was published on October 6, 1649, according to Thomason, whose dating of Milton's Work is usually reliable. Milton was a friend of the Thomason family (see Milton's sonnet XIV on the death of Mrs. Catherine Thomason), and a number of Milton's books in Thomason's collection were marked *ex dono authoris*. Internal evidence in Eikonoklastes also precludes a publication date much earlier than October 6, since Milton in the third from the last paragraph in the last chapter refers to the beginning of Cromwell's subjugation of Ireland, the first news of which reached England and was published in September, 1649.

A second edition of Eikonoklastes, not included in the Thomason collection, was published in 1650. One insertion, p. 208 of Chapter XXVII in the second edition, a reference to the death of Antony Ascham in Madrid in the summer of 1650, puts the publication of the second edition no earlier than late June, 1650.

A so-called third edition (actually a reprint of the first) was published at Amsterdam in 1690. In an attempt to counteract the influence of the "King's Book" on the Continent, there was issued a French translation by John Durie of the second edition of Eikonoklastes during the last week in November in 1652.

Since the three English editions (and the one French edition) in the seventeenth century, there have been two separate editions of Eikonoklastes, both based on the 1650 (second) edition and edited by Richard Baron in 1756 and 1770. All other editions of Eikonoklastes have occurred in collected works of Milton.

The present text is a photographic facsimile of a copy of the second edition of Eikonoklastes in the New York Public Library. The use of a facsimile text does away with the errors of the best modern text and makes it possible to bring the texts and notes together in one volume. The explanatory notes bear page numbers referring to the printed page numbers of this text.

Microfilm \$4.20; Xerox \$14.20. 327 pages.

# LE JALOUX AND HISTORY: A STUDY IN MEDIAEVAL COMIC CONVENTION

(L. C. Card No. Mic 58-7872)

Paul A. Olson, Ph.D.  
Princeton University, 1957

The primary aim of this thesis has been to place the mediaeval Jaloux tale in its philosophic and historical framework. Chapter One examines the roots of the tradition in patristic writing and the development of its iconological associations in later mediaeval literature. It is suggested that the marriage controversies of St. Augustine and Jerome with the Pelagians, Manichee, and Jovinians each gave rise to a Jaloux type which was used in later mediaeval literature to dramatize the love of some set of values. Thus, from the Jovinian controversy, specifically from the Adversus Jovinianum, came a comic deceived husband who emblemized man's tendencies to become over-involved in material good. The Jaloux which St. Augustine created in his anti-Manichean polemics embodied the jealousy of God and his will to preserve spiritual or eternal values. Finally, from the Pelagian disputes came a type who, like the first Adam, faces the problem of choice between alternative goods, the spiritual or the material. In later literature, from Jean le Fevre to Alanus de Insulis and Boccaccio, these three types were the source of a rich and complex literary symbolism concerned precisely with the problem of values, with the kind of "woman" or good which the jealous man seeks to possess.

In the twelfth and thirteenth centuries when the beginnings of the commercial revolution produced the first concerted reaction against the assumption that man's good is primarily spiritual, the three jealous husband types were seen to be particularly vivid embodiments of a complex of attitudes which various classes might take toward the new materialism. Two areas in which this interaction between the history of the acquisitive classes and the Jaloux convention is particularly striking have been selected as the focal points for the remainder of this study: twelfth and thirteenth century Orleans and Chaucer's England. The second chapter is concerned with the battle between the old and new orders in the Orléanais, with the potential for anti-acquisitive satire which humanists of the Loire schools found in the patristic jealous husband types and in their own classical tradition. The third and fourth chapters deal with similar tensions as they appear in Chaucer's tales of deceived husbands, those told by the Miller, Reeve, Manciple, Shipman, and Merchant. In each of these later chapters, emphasis is placed not on the poet's use of history and iconology for their own sake but on the interaction of the two and on the rather striking aesthetic effects which are produced by that interaction. In this light, the tales of Chaucer and the Orléanais humanists are worthy of attention not only as humanistic defenses of a classical, theocentric form of civilization as opposed to a capitalistic one, but they become comedy worthy of the name in their own right.

Microfilm \$4.60; Xerox \$15.40. 360 pages.



THE ATTITUDE OF SOME ENGLISH LIBERALS  
TOWARD NAPOLEON AS REFLECTED IN THE  
EDINBURGH REVIEW AND LEIGH HUNT'S EXAMINER

(L. C. Card No. Mic 59-561)

Ahmad Hasan Qureshi, Ph.D.  
University of Illinois, 1958

Drawing upon the Edinburgh Review for the period from 1802 to 1842 and the Examiner from 1808 to 1825 this study deals with the attitude of a group of English liberals who attempted to criticize the actions of Napoleon and to evaluate his character in an impartial manner. Hunt and the Edinburgh Reviewers studiously kept an eye on the vices and virtues of Napoleon in their numerous estimates of his character. Their declared objective was to steer clear of the extremes of hero-worship and open abuse. They condemned Napoleon for his denunciation of Liberty, for his suppression of the liberty of the Press, for his subjugation of Spain, Holland, Switzerland, for his tyrannic rule in France, for his career of conquest and personal aggrandizement, for his outrageous temper, and for his inordinate political ambition. The Examiner and the Edinburgh Review commended Napoleon for espousing the cause of Liberty in the early part of his career, for inculcating a sense of national unity in Germany and Italy, for his Civil Code, for his abolition of abuses like the hated Inquisition, and for overthrowing decadent feudalistic monarchies. They recognized his unprecedented genius for war but refused to place him high in the scale of moral greatness.

The English liberals viewed Napoleon as a product of the forces and an instrument of the tendencies which created the Revolution in France. In so far as his actions promised to perpetuate the constructive tendencies of the Revolution they praised him; but they deplored the fact that Napoleon threw away great opportunities for doing good to the world. He could, for instance, have helped the abolition of slavery and the establishment of free trade and freedom of religious worship; he could have rid Europe of feudal governments and replaced them by constitutional governments. Leigh Hunt held that Napoleon's defection from the cause of Liberty could be traced to the faulty military discipline of Bourbon France which had fostered a love of false glory and insatiable political ambition in the mind of the Corsican soldier.

Leigh Hunt and the Reviewers maintained an attitude of dignified aloofness in the heyday of Napoleon's power; their vision was not beclouded by the violence of partisan passions of the time. In the years of Bonaparte's captivity at St. Helena they recommended a treatment worthy of the dignity of the English nation. During his lifetime these liberal critics considered Napoleon primarily as a soldier, a usurper, and a conqueror worthy to be hated but not despised for his inordinate ambition and vainglory. After Bonaparte's death the Examiner and the Edinburgh Review gave the French Emperor full share of credit for his capacity for civil affairs. After Waterloo Napoleon's humane qualities which had been obscured by the blaze of his former triumphs became the object of the study of the two periodicals. He was found to be more free of the crimes of ambition than other conquerors and his vices were interpreted as a part of the heritage of the frailties of human nature. His winning manners, generosity, and patient endurance of misfortune now claimed their attention. It may be pointed out that Leigh Hunt frequently used

Napoleon as a yardstick to measure the abuses and imperfections of the English government and the social and political abuses of the rest of Europe. His sympathy with the prisoner of St. Helena frequently became a matter of soft sentiment for a fallen foe.

Microfilm \$3.10; Xerox \$10.60. 238 pages.

THE WORKS OF ARTHUR MACHEN:  
AN ANALYSIS AND BIBLIOGRAPHY

(L. C. Card No. Mic 59-814)

Wesley Duane Sweetser, Ph.D.  
University of Colorado, 1958

Supervisor: Professor Leslie L. Lewis

The purposes of this thesis are as follows: to provide a chronological compilation of the facts of Machen's life, to compile a more accurate and complete bibliography than has heretofore been presented, to evaluate definitively the whole of Machen's works, and to arrive at conclusions concerning his literary immortality.

Three basic factors of Machen's life affected all of his works: first, his compelling urge to write led to a voluminous production over a period of more than sixty years; second, the environment of his early childhood--wild Wales, where the folk-lore, legend, Christianity, and the remains of the Roman occupation all merge with the natural setting to form a living, yet historical reality--provided the setting and much of the material for his tales and romances and developed his mystical approach to life; and third, an early acceptance of Plato's philosophy made him a confirmed mystic idealist for the whole of his life.

He experimented with almost every literary form, but confined the major portion of his work to essays and tales. For inspiration, sources, and materials, he drew primarily upon three periods--the Romantic, the early Stuart, and the medieval--which stand in opposition to rationalism, materialism, and outward expansion. Authors whose influence was greatest are Stevenson, Poe, Coleridge, De Quincey, Lamb, Burton, Rabelais, Malory, and medieval occultists, alchemists, and demonologists. The Mabinogion and Arabian Nights were always in his mind. In addition, indirect influences were numerous; and literary echoes of the aesthetic-decadent school are apparent.

From a natural linguistic ability he developed an outstanding and versatile style. His translations savour of the original; and in other work he imitated such masters as Burton, Poe, Stevenson, Coleridge, and Lamb. His style ranged from naturalism to incantation, and during his journalistic days he adopted a reportorial style; but his natural style used in letters and essays was faintly archaic, echoing the 17th century. Even his journalistic work, though often unsigned, is written with distinction and is usually clearly recognizable.

Penetrating all his works is a pervasive romantic attitude, and many of them contain a strong undercurrent of mysticism. His largest body of creative work lies in the realm of the weird and occult, and these tales are more likely to survive than any others. Even in these, however, he is expressing by means of pagan, Christian, and Celtic symbolism his single transcendental theme that the reality which lies hidden beneath the surface can never be found and never be revealed.



Among his works most eligible to survive are The Hill of Dreams, a symbolistic picaresque of the soul; Hieroglyphics, a book of impressionistic criticism; Dog and Duck, a collection of personal essays; The Rose Garden, a mystical prose poem; and the following weird and occult tales which best typify his varied styles and techniques: The Novel of the White Powder, The Novel of the Black Seal, The Bowmen, The Terror, The Great God Pan, and The White People. In addition, his translation is the accepted English version of Casanova's Memoirs.

The bibliography, though still lacking in certain journalistic articles, particularly in the Evening News, and in reviews of his works in obscure journals, is, nevertheless, the most complete yet published and reveals that Machen has survived in a limited way. His appeal lies with occultists, mystics, intellectuals, bohemians, and particularly with avid readers of tales of terror and the supernatural; and in each case, that appeal arises from his encompassing concern with the ineffable mystery.

Microfilm \$6.20; Xerox \$21.60. 488 pages.

#### HAWTHORNE'S TRANSMUTATIONS OF PURITANISM

(L. C. Card No. Mic 58-7957)

John Golden Taylor, Ph.D.  
University of Utah, 1958

Chairman: Don D. Walker

Hawthorne's relationship to Puritanism has been widely assumed in a general way but nowhere examined in detail. Everyone knows of Hawthorne's lineal descent from a stern persecutor of the Quakers and of his writing tales with Puritan settings, but few are aware of the extent and nature of his adaptations of his source materials. It is the problem of the present study to determine in specific detail the nature of Hawthorne's artistic use of Puritan history and thought. I have limited the scope of this study to a consideration of only those sketches and stories by Hawthorne which deal centrally with New England Puritanism largely within the seventeenth century. After identifying miscellaneous elements of Puritanism in the sketches and didactic tales I give detailed consideration to the major literary works. My procedure is to identify the main elements of history and art in each of the tales considered and to summarize and draw conclusions on the relationships and divergencies that exist between historic Puritanism and Hawthorne's ostensible representations of Puritanism.

I proceed on the basis of the following seven hypotheses: (1) that Hawthorne is generally thought to be an authentic portrayer of New England Puritanism; (2) that Hawthorne was, in reality, primarily a creative artist and wrote without the concerns or the restrictions of a scientific historian; (3) that, as an artist, Hawthorne quite freely and legitimately transmuted New England Puritanism, historically and philosophically, to meet his preconceived artistic designs; (4) that Hawthorne approved some aspects of Puritanism and repudiated others: his artistic representation of Puritanism, is, therefore, seen in both positive and negative symbols; (5) that Hawthorne's ambivalence toward

Puritanism is based on the conflict between his filiopietistic attachment to Puritanism (in spite of its bigotry and harshness) and his enlightened nineteenth-century, democratic tolerance; (6) that Hawthorne's technique and meanings are more clearly revealed by such analyses; and (7) that historic New England Puritanism is more accurately seen for what it was when it is divested of the transmutations of Hawthorne's art.

Hawthorne's transmutations of Puritanism take three forms: affirmation, ambivalence, and repudiation. In "Legends of the Province House," "Endicott and the Red Cross," and "The Gray Champion" Hawthorne makes his major affirmations by seeing Puritanism as the incarnate spirit of dissent, democratic government, and individual human value in conflict with the pride and power of English royalty. "The Maypole of Merry Mount" and "The Gentle Boy" represent Hawthorne's ambivalence toward Puritanism. He finds the excessive gloom, bigotry, spiritual pride, and harshness of the Puritans a violation of the ideal on one extreme and the laxity of the revelers and the fanaticism of the Quakers equally unreliable on the other. In both tales he finds a middle ground in which a young couple withdraws from the complete association with one group in order to assimilate the good from the other way of life. Here more than anywhere else Hawthorne makes an atonement for his ancestors and other Puritans. Here he also takes the greatest liberties with history.

In "Young Goodman Brown" and "The Minister's Black Veil" Hawthorne chooses to expose the devastating effects of believing the basic Puritan conception that "Evil is the nature of mankind." Using in the one the paraphernalia of witchcraft and in the other a morbid eccentricity, Hawthorne shows doubt of the existence of good in one's fellows alienates him and defeats life. It is in his hierarchy of sins that Hawthorne makes his major transmutation of Puritanism in The Scarlet Letter. With neither the Puritans nor Hawthorne is either adultery or hypocrisy the worst of sins. With the Puritans apostasy from their variety of reformed Christianity is the most heinous; with Hawthorne the unpardonable sin is Chillingworth's hate.

Microfilm \$3.80; Xerox \$12.80. 293 pages.

#### JOHN GOULD FLETCHER, POET: THEORY AND PRACTICE

(L. C. Card No. Mic 59-235)

Bernard Philip Zur, Ph.D.  
Northwestern University, 1958

Supervisor: Ernest Samuels

This study analyzes the origins and development of the critical principles of John Gould Fletcher as they are revealed through his poetry and prose.

Chapter one consists of a short biographical sketch emphasizing Fletcher's early education, the literary figures to which he was attracted, and significant facts surrounding his life in the colonial mansion which left so strong an impression upon his life and work.

The second chapter is concerned with the poet's impressionistic indoctrination, analyzes the techniques of the Symbolists, and relates Fletcher squarely with French



impressionism, particularly with the methods of Rimbaud, Verlaine and Baudelaire; it also examines the sources of Fletcher's mood-landscape techniques, the origins of his romantic emotionalism, and discloses the inception of some of the poet's critical attitudes as they are revealed in his poetry.

Chapter three investigates the origins of Fletcher's belief in dionysiac *élan*, the growth of his mood-landscape analogies in his first mature verse, and shows the poet on the way to the establishment of two of his most lasting artistic concepts; his belief in *transposition d'art* and his enthusiastic utilization of the tonal resources of language to convey impressions. Fletcher's modifications of the *alchimie du verbe* experimentation of Rimbaud, and Fletcher's contribution to color symphony traditions are developed in this chapter.

Chapter four considers the indebtedness of the Imagist school to T. E. Hulme, compares and contrasts Fletcher's imagistic concept with that of the Imagists, and concludes that Fletcher, a romantic realist, relied to a greater degree than his fellow Imagists upon emotion as an energizing force in poetry.

Chapter five undertakes to establish Émile Verhaeren as one of two major influences upon Fletcher (the other being Walt Whitman) and to show that Verhaeren was responsible for much of Fletcher's poetic and critical indoctrination. More particularly, this phase of the study demonstrates the impact of Verhaeren upon Fletcher's mood projection techniques, his contributing force in bringing Fletcher to a renunciation of forms and conventions, his strengthening of Fletcher's fondness for cataloguing methods and techniques of externalization, and contends that in Verhaeren there existed a compelling precedent for transmuting the tumultuous forces of nature into poetry in which the rhythms of nature become the rhythms of prosody. Verhaeren, lastly, is presented as the poet who strengthens Fletcher's already well-formed notion that poetry is to be conceived as dithyramb.

The sixth chapter associates Fletcher in practice and spirit with Walt Whitman, traces Fletcher's early admiration of Whitman to his mature emulation, and parallels the major aspects of their broad and sweeping correspondence: a similarity of mythic aspiration, their dual attractions to lyricism and to strong realism, their alternations between the real and the mystical, their confidence in multiplicity, their sympathetic concern for mankind, and a constantly insinuating likeness of poetic style and technique.

Chapter seven, taking its cue from Fletcher's claim that Orientalism was used by the Imagists as a crystallizing force, considers the relationship between the two literatures and opposes Fletcher's methods of indirection to the objectification and incisiveness of the Orientalist.

The eighth chapter, contending for the originality of polyphonic verse as a contribution to the new poetry, discusses the free verse - prose controversy, and traces some of the origins of free verse into its particular utilization by Paul Fort, Amy Lowell and Fletcher.

Chapter nine synthesizes Fletcher's opinions on the big questions and reaches two major conclusions: first, that from a failure to construct a unified body of faith, and because of the growing scepticism and melancholy, Fletcher's poetry gradually lost force; secondly, that the attempt by the poet to express his cosmic philosophy in his late works did not succeed, but that he made nonethe-

less a significant contribution to the regional literature of the Southwest. Microfilm \$4.35; Xerox \$14.60. 340 pages.

## LANGUAGE AND LITERATURE, CLASSICAL

### A STUDY OF MORALIZATION IN LIVY

(L. C. Card No. Mic 59-1160)

Lydia Halle, Ph.D.

Bryn Mawr College, 1958

Our study began with Livy's statement in the preface that moral instruction is the chief benefit to be derived from the study of history, and we proposed to examine the consistency with which he applies that principle in his own history. We detected in him a strong pessimistic tendency: he prefers to emphasize the bad example that is to be avoided rather than the good example that is to be imitated. Two methods of moralization were discovered and analyzed. The first or direct method consists of examples directly labeled by the words *documentum* or *exemplum*. From the nature of the situations and the qualities which he designates by these words we deduced that Livy applies them deliberately for purposes of moralization. Moreover, the manner of his application and the words with which he qualifies *documentum* and *exemplum* indicate a dominant pessimism.

The second or indirect method was found to be more complex. We considered both the use of metaphors drawn from sickness and health and the criticism of particular vices and faults. Although metaphors from sickness and health are not uncommon in classical literature, Livy seems to use them with moralizing significance to convey approval by the terminology of health and disapproval by that of disease. We investigated his technique in detail with regard to his treatment of the Roman mutiny in Spain and the madness of Syphax in abandoning the Roman alliance. To evaluate the other aspect of this method, the criticism of vices and faults, we analyzed his handling of *amor*, *cupido*, *libido*, *avaritia*, and *superbia*. The most important points revealed by this analysis are the following. First, that Livy holds public and political manifestations of vice to be the most reprehensible is evident from his severe censure of Roman magistrates who display any of the vices discussed and from his method of protecting collective Roman honor from possible external criticism, after a single Roman has injured non-Romans. Second, Livy moralizes with the greatest vigor on the vices *regni cupido* and greed for extended and extensive power. This leads one to suspect that contemporary events motivate his moralization. His elaboration on *superbia* in connection with the Tarquins makes it probable that this vice was as significant as *cupido* in the complete work. Third, we note a subordinate moralizing technique, the repetitive use of a character in situations whose moral, but not necessarily factual, aspects are similar; this use may be for the purpose of criticism, as in the case of Ap. Claudius the decemvir and Ap. Claudius the censor, or for the purpose of approbation, as in the comparison between Q.



Fabius Maximus and Aemilius Paullus. Levy seems consistently to apply both indirect methods. From this and from his equally consistent use of the direct method we concluded that he fulfils in the body of the work the intention expressed in the preface: moral instruction is his prime purpose as an historian.

Microfilm \$2.80; Xerox \$9.80. 216 pages.

A LATIN TRANSLATION OF THE  
PSEUDO-ARISTOTLE *DE MUNDO* BY ARGYROPOULOS:  
TEXT AND ANALYSIS

(L. C. Card No. Mic 58-3363)

Grace Freed Muscarella, Ph.D.  
University of Pennsylvania, 1958

Supervisor: Dr. Lloyd W. Daly

In the manuscript collection of the University of Pennsylvania Library is a volume which contains several Greek cosmological treatises in Latin translation (Rare Book Collection, Latin Manuscript 13). The second treatise, Pseudo-Aristotle, *De Mundo*, is of particular interest and is the subject of this study. It appears in a Renaissance translation hitherto unpublished and unknown, attributed to Ioannes Argyropoulos (1415-1487), a Byzantine scholar who, after the fall of his native Constantinople, worked at Florence teaching and translating under the patronage of the Medici.

This paper presents a critical text of Argyropoulos's translation, analyzes the implications of its relationship to the Greek manuscripts and other translations of the *De Mundo*, and discusses it in relation to the study of Argyropoulos's life, his other translations, and his style as a translator.

The introduction deals briefly with the authorship, date, and contents of the *De Mundo* and the known Latin translations of it: the ancient version attributed to Apuleius; the mediaeval versions of Bartolomeo da Messina and Nicholas Siculus; and the Renaissance translations of Rinucius Aretinus, Argyropoulos, Peter Alcyonius, Guillaume Budé, and Jacobo Sadoletto.

The critical edition of the text of the Argyropoulos translation is divided into several parts: the text itself; an *Apparatus Criticus*, an *Apparatus Graecus*, and two Appendices. The *Apparatus Criticus* contains glosses and marginalia from the manuscript, an explanation of the emendations, and other pertinent notes. The *Apparatus Graecus* is a comparative analysis of the Greek text underlying the Argyropoulos translation. The readings of this restored text have been compared with the readings of the Greek codices and with the readings as restored by W. L. Lorimer from the Armenian, Syriac, and Latin versions.

Appendices A and B form a supplement to the *Apparatus Graecus*. Appendix A, "Textual Problems", deals with thirty-one particularly difficult passages in the text of *De Mundo* and shows the position of the text underlying the Argyropoulos translation as to these problems. In Appendix B, "Manuscript Tradition", the correspondence of the text Argyropoulos used with codex Z of the *alpheia* branch of the manuscript tradition of *De Mundo* has been demonstrated by an analysis of a series of significant readings and of agreements *contra mundum*. A Byzantine ancestry

is suggested for *alpha*, the hypothetical ancestor of the *alpheia* class, and the history of Z is reviewed.

Appendix C is concerned specifically with the Greek text of *De Mundo*. Two brief fragments of that text (392a23-29, 399a6-11), preserved in a tenth century manuscript in the Bibliothèque Nationale, Fonds Coislin, 249, are given in full, discussed, and compared with the readings of the codices and of the modern text. This manuscript is of particular interest, since it is earlier in date than any of the known codices of *De Mundo*.

The last two Appendices deal with Argyropoulos. Appendix D, "The Chronology of Argyropoulos's Translations", dates all of his known translations, at least approximately; the material is developed within the framework of his biography. His work falls into three periods: the Medici period (1456-1469); the Transitional Period (1469-1481); the Roman period (1481-1487). His translation of *De Mundo* seems to have been made about 1471.

Appendix E, "The Attribution to Argyropoulos and Argyropoulos's Style", demonstrates that the attribution of the translation of *De Mundo* to Argyropoulos is correct. Stylistic similarities to his other translations are discussed, while stylistic differences are shown to be the result of the unfinished state of the translation. The characteristics of Argyropoulos's style are analyzed. In conclusion the criticism which his translations received, both positive and negative, is discussed.

Microfilm \$2.30; Xerox \$8.00. 174 pages.

SOME TECHNIQUES OF DEVELOPMENT IN  
PROPERTIUS AND THEIR BEARING  
ON POEM DIVISION

(L. C. Card No. Mic 59-63)

Ronald Erwin White, Ph.D.  
The University of North Carolina, 1958

Supervisor: B. L. Ullman

The introduction gives a brief history of the various methods of textual revision which have been used extensively on the text of Propertius; these methods include emendation, transposition, the assumption of lacunae, and deletion on the ground of interpolation. While the first three methods are treated briefly and generally, interpolation receives detailed discussion on account of its recent prominence.

The major problem taken up in this dissertation is the division of the elegies. This involves poems treated as separate in the manuscripts and those broken up by editors. It is pointed out that the manuscripts are not always reliable in this respect and that internal evidence is therefore the best possible determining factor in the division of the poems. In using internal evidence, one must perform a specific series of analyses before recommending the proper disposition. The subject matter of the sections which comprise each poem must be determined and their coherence judged. If their subject matter is identical or closely related, and if there is an artistic interaction among the sections, the interpreter should decide that the manuscripts are correct in treating these sections as one poem. If, on the contrary, there is no such relationship of



subject matter and no such interaction, the connection made by the manuscripts should be suspected. The interpreter's next step is to consider the possibility of close relationship between the divergent section and the poem which follows or precedes in the manuscripts. If he finds a demonstrable relationship, he is justified in suggesting that this section be separated from those sections with which it is incoherent and attached to the adjoining poem. If there is no demonstrable relationship, he should propose that the section stand by itself as an independent elegy, or, if it seems incomplete, as a fragment. We must consider, moreover, whether or not two adjoining poems appear so closely related in subject matter and treatment that they seem to have been composed by the poet to comprise one rather than two poems.

Whereas identify of subject matter is usually clearly distinguishable, interaction between separate elegies or the parts of one elegy often requires considerable interpretation. One must take into account Propertius' unique talent, of which one striking characteristic is his penchant for ellipsis of thought. One aspect of this characteristic is a purposeful abruptness of transitions. This device requires that the reader understand as occurring immediately before the transitional couplet an unexpressed passage of time during which some unexpressed event has taken place. The term "dramatic" has been applied to this type of development by analogy to the dramatic practice of representing action and passage of time as occurring between acts of a play. Propertian poems which are held in this dissertation to evince dramatic development are: I, 8; II, 28; II, 29; II, 33; II, 34; III, 20.

Sometimes Propertius' transitions are abrupt without being dramatic in the sense described above. Such a case is found in II, 13, whose unity also is defended. The problem of division has been discussed also in connection with five pairs of closely related poems: II, 2-3; II, 17-18; II, 23-24; II, 26-27; III, 24-25; in the case of each pair, an arrangement different from that of the manuscripts has been suggested on the basis of a careful study of the internal evidence. Microfilm \$2.45; Xerox \$8.60. 186 pages.

#### LANGUAGE AND LITERATURE, LINGUISTICS

##### A SEMANTIC STUDY OF GOTHIC AND OLD ICELANDIC WORDS FOR ORAL EXPRESSION

(L. C. Card No. Mic 59-1000)

Katherine Oline Aston, Ph.D.  
Bryn Mawr College, 1958

This study is a semantic investigation of Gothic and Old Icelandic words in the following categories of Oral expression: Voice; Song; Speech; Language; Word; Question Answer; Tale; Name. The work is divided into three sections: 1. Gothic Expressions. 2. Old Icelandic Expressions. 3. A comparative Study of the Gothic and Old Icelandic Expressions.

In general, the material is arranged according to word families. Compounds are also given because of their

importance in determining the field of meaning for a word group.

In the first two sections such passages as are important in determining the exact shade of meaning are quoted. The Greek equivalent of the Gothic word is also given.

To establish more definitely the total scope of meaning, its origin and diversity of development, for some of the key words of the preceding sections, an etymological survey is offered in section three. Although this survey is primarily within the Germanic dialects, it includes related words from other Indo-European languages insofar as these words have significance for this study.

Microfilm \$7.60; Xerox \$26.00. 598 pages.

##### A LINGUISTIC STUDY OF THE JOURNALS OF THE CORONADO EXPEDITION

(L. C. Card No. Mic 59-841)

Clevy Lloyd Strout, Ph.D.  
University of Colorado, 1958

Supervisor: Professor Stuart Cuthbertson

This study was undertaken in order to ascertain the types of vocabulary used by the chroniclers of the Coronado expedition to record their experiences and to name the items discovered, and the methods by which they applied the vocabulary, as well as to initiate a chronological list of borrowings from the native New World tongues. It was suggested by a similar study of E. H. Criswell, Lewis and Clark: Linguistic Pioneers.

A complete lexicon was made of all the words found in the chronicles, for in order to ascertain what was new it was necessary to be able to compare the standard vocabulary with the introductions and previously unrecorded terms, as used by the writers. This lexicon can, thus, be used as a basis for further studies of other writings of the early colonial period of the conquistadores.

The Spanish language of these Journals shows a high degree of conservatism. These men were conquistadores, and their mental make-up rejected the idea of borrowings as an act not worthy of themselves, as a general rule. To be sure, they borrowed when no other recourse was available, but the number of these borrowings amounts to less than one percent of the total entries in the lexicon.

Many of the borrowed terms had already entered the Spanish language by way of the Antilles, before this expedition took place. One is led to the conclusion that, for these particular writers, the borrowings were primarily in the nature of exoticisms to add interest to their accounts.

The language of the Journals shows the primary interest of the writers. These men were explorers on an exploration, not scientists on a scientific expedition. They were soldiers, and approximately one third of the vocabulary used reflects this background. An emphasis is laid upon the military aspects of the expedition, but great attention is also paid to the aspects of the area which would prove of utility for settling the land--natural resources, climate, agricultural possibilities, native population as a source of labor for exploitation of the land. It was hoped that an area rivaling Mexico and Peru in wealth would result from this expedition, a hope some centuries in anticipation of actuality.



But, more than this, the words afford a history of the men themselves as well as a history of the times. The impact of environment on the men is gleaned from their choice of vocabulary to express their reactions, both toward their new environment and toward their comrades-in-arms. The words afford an insight into their daily life under heroic circumstances, what their interests were, their thoughts concerning conditions of life in which they found themselves, and their hopes and aspirations.

As E. H. Criswell said: "A history of the words used by a race or a nation implies a history behind it of the things these words denote, and the two taken together constitute a history of the race or nation itself."

Microfilm \$12.05; Xerox \$43.40. 964 pages.

### THE STRUCTURE OF TWO-WORD VERBS IN ENGLISH

(L. C. Card No. Mic 58-1672)

Abdul Karim Taha, Ph.D.  
The University of Texas, 1958

Supervisor: Archibald A. Hill

This study set out to investigate the structural features of two-word verb constructions such as: call down, find out, pick up, etc., which consist of a verb followed by the adverbial use of an ad-prep. To achieve this objective, a large body of utterances with two-word verbs was obtained directly from native speakers of English. Each of these utterances was carefully recorded with its stress, juncture, and order characteristics.

By employing stress as a criterion, two-word verbs used in these utterances were classified into: (1) intransitives, and (2) transitives. It was found that the stress-pattern of constructions of the former group is /˘˘/ in medial position, as in: Hè fèll dōwn òn thě jób # and /˘˘/ before a terminal juncture, as in: Jòhn gòt dōwn #. The stress-pattern of constructions of the latter group, on the other hand, is /˘˘/ in utterance-medial position in which the complement is not an utterance-final pronoun, as in: Hè cút dōwn hīs smōking # and Māry rān dōwn thě hīll #. When, however, the complement is an utterance-final pronoun, as in: Māry rān dōwn It # or when the ad-prep occupies a position before a terminal juncture, as in: Hè cút hīs smōking dōwn # the stress-pattern becomes /˘˘˘/.

The other structural feature of two-word verbs is their word-order. Insofar as this feature is concerned, it was observed that some constructions always take the contiguous order only, others take the noncontiguous order only, and still others take either the contiguous or the noncontiguous order. Those constructions which take the contiguous order only include all the intransitives, as in: Mỹ wāch hās rùn dōwn # and some transitives, as in:

Thě mōwer mōwed dōwn thě bānk #

Thě mōwer mōwed dōwn It #

In contrast to this contiguous order-group there is another noncontiguous order-group which is occupied by some transitives, as in:

Hè tried tō yēll hīs wīfe dōwn #

He tried tō yēll hēr dōwn #

In addition to these two groups of constructions, there is another group of transitive constructions which can take either the contiguous or the noncontiguous order. In some instances this choice in order is accompanied by a clear distinction in meaning, as in:

Hè jūmped dōwn thě hórse #  
(i.e., he jumped down from the horse.)

Hè jūmped thě hórse dōwn #  
(i.e., he forced the horse to jump down.)

In other instances, however, no such semantic distinction exists, as in:

Ròll dōwn yòur sléeves #

Ròll yòur sléeves dōwn #  
(i.e., pull them down.)

Whatever the order of the two-word verbs may be, it was noted, as the result of grouping samples of these constructions into immediate constituents, that the verbal element and the following adverbial use of the ad-prep always fall together in the same layer of construction. This result is revealed and confirmed by the structural signals of stress, juncture, and pitch. Other evidence which confirms the unity between the verbal element and the adverbial use of the ad-prep is the fact that the latter always forms a member of the predicator. All these evidences indicate that a two-word verb construction is a combination of a verb and the adverbial use of the ad-prep.

Microfilm \$2.20; Xerox \$7.80. 166 pages.

### EL ANGLICISMO EN EL HABLA COSTARRICENSE

(L. C. Card No. Mic 59-667)

Virginia Zúñiga-Tristán, Ph.D.  
Tulane University, 1958

Chairman: Daniel Wogan

Esta tesis se propone presentar un glosario de los anglicismos usados en el habla costarricense. Se incluyen 1024 términos ordenados de acuerdo con el siguiente plan: 1) El anglicismo; 2) La pronunciación escrita en alfabeto fonético; 3) La parte de la oración a que pertenece el vocablo; 4) La etimología; 5) La definición del término en el habla del país; 6) La frase u oración que incluye el anglicismo tomada oralmente; 7) La cita que incluye el anglicismo y la fuente bibliográfica de donde se obtuvo; 8) Las variantes; 9) Observaciones: la distribución geográfica; la vía de adopción del vocablo; el nivel social; la frecuencia en el uso; la difusión social; el uso de acuerdo con los sexos; y las referencias a trabajos anteriores. Además se incluyen cuatro apéndices que contienen: A) Los vocablos toponímicos; B) Las frases y oraciones anglicadas; C) Los cuadros estadísticos del movimiento migratorio de personas de habla inglesa; y D) Los mapas que muestran los principales focos de difusión de anglicismos.

Del total de vocablos que se presentan en el glosario, el 79.16% corresponde a sustantivos, el 11.75% a adjetivos, el 7.71% a verbos, el 1.29% a adverbios y el 0.09% a interjecciones. Se encontraron tres focos geográficos de bilingüismo: 1) San José, la capital de la República, 2) la zona bananera del Pacífico y 3) la zona atlántica.



La acción del superestrato inglés en el habla costarricense ha dado los siguientes resultados: en la fonética, el uso del sonido [ʃ]; en la fonología, la presencia del fonema /s/, el empleo de los fonemas consonánticos /f/, /p/, /c/, /s/, y /k/ y del diptongo /ou/ en posiciones que no son las normales en español; en la morfología el uso de tres verbos que no presentan las desinencias de los verbos españoles. No se encontró una influencia considerable en la sintaxis. Por lo común, los vocablos que han penetrado por vía oral mantienen el acento inglés. En los casos en que el término ha sido adoptado por vía escrita o en que ha influido la grafía, el acento inglés se disloca. Los vocablos compuestos generalmente muestran el acento oxítono.

Los préstamos se clasificaron en la siguiente forma: 1) Préstamos totales: pertenecen a esta clase los vocablos importados sin sustitución fonémica, morféica ni semántica. 2) Préstamos parciales: a) híbridos, combinación de fonemas y morfemas ingleses con fonemas y morfemas españoles; b) extensiones, vocablos que presentan una nueva distribución de morfemas españoles en imitación de un modelo inglés; y c) préstamos de forma, vocablos importados cuyo significado original se ha sustituido por otro totalmente distinto.

Microfilm \$4.80; Xerox \$16.00. 373 pages.

#### LANGUAGE AND LITERATURE, MODERN

##### HENRY FIELDING'S "ART OF LIFE": A STUDY IN THE ETHICS OF THE NOVEL

(L. C. Card No. Mic 58-5111)

Charles DeLoach Ashmore, Ph.D.  
Emory University, 1958

A major critical problem with respect to Henry Fielding is posed by the lack of detailed information concerning his moral attitudes and his ethical motives in the novel. As a step toward the solution of this problem, the present investigation undertakes to discover the principal features of his ethical philosophy and the importance of moral purpose in his works.

The philosophers of the Restoration and early eighteenth century divorced ethics from religion and pursued an intensive study of morality as a secular, quasi-scientific subject. Certain major issues emerged as focal points of the discussion, such as (1) the effort to prove, in answer to the moral relativism of Hobbes, that morality is eternal and immutable; (2) the dispute as to whether intellect, sentiment, or a moral sense is the faculty which perceives moral distinctions; and (3) the study of the rôles of self-love and benevolence in the relations between men.

This discussion of ethical issues from Hobbes onward nourished Fielding's moral thought. But he was a very practical man, with an inclination toward common sense rather than abstract speculation; and, although he had great respect for the ancient philosophers and some moderns, such as Locke and Shaftesbury, he was generally critical of philosophers because of their abstruse and speculative methods. He recommended his new novel form

as a better device for teaching morality than moral treatises or even sermons because it offered examples of good and evil, not mere precepts or rules of conduct.

The evidence of moral purpose in Fielding's work is sufficient to prove the fallacy of criticism which brushes off his moral professions as hollow conventionality. Few novelists, indeed, have displayed a more earnest ethical purpose than Fielding. When we assemble the "ART OF LIFE" which he taught in his novels, we find that, as the thought of a popularizer, it has impressive consistency and the force of strong conviction. After Shaftesbury, argument about the individual moral agent had centered on the nature of the ethical faculty. Bishop Butler and David Hume, the outstanding moralists of Fielding's age, declared that this faculty is a moral sense including both reason and sentiment. Fielding appears to have accepted this opinion, for he insisted that the best life is attainable only by those men who possess a proper balance of head and heart. In the area of social ethics, too, he followed the leaders of contemporary thought. He believed that man is basically good and that the evil which exists in the uncultivated person can be refined away by proper education. Further, he held that man is a social animal and finds his greatest happiness in harmonious adjustment to society. The issue of self-love versus benevolence, a focal point of ethical discussions in Fielding's century, became the basis of his distinction between evil conduct and good conduct; in fact, he went to the extreme of defining evil almost exclusively in terms of selfishness and good in terms of generosity or benevolence.

The reference points for most of Fielding's moral pronouncements were his two dichotomies--head and heart for the individual, and self-love and benevolence for society--and he achieved a truly philosophic outlook upon life by bringing all the varied details of his experience into the unity of his thought. The positive and enduring ethical contribution he has made through the novel is a recommendation of generosity which goes beyond the normal, conventional bounds of thought in his own age and in any succeeding age. Fielding is not flippant, nor is he shallow; he has something of value to communicate to those of any century who are selfish, who deceive themselves, or who uncharitably insist upon judging men only by their outward conduct, without probing the inward nature to evaluate the heart and motive.

Microfilm \$4.45; Xerox \$14.80. 345 pages.

##### EXPANDING THEMES IN THE NOVELS OF E. M. FORSTER

(L. C. Card No. Mic 58-7347)

Betty June McLain Belvin, Ph.D.  
University of Washington, 1958

Until E. K. Brown wrote on Forster's "Expanding Symbols" and "Interweaving Themes" even Forster's most appreciative critics failed to give serious attention to these essential aspects of his novels. Even Brown was interested in Forster principally as his method could be seen in other novelists. James McConkey made a more extensive study of Forster's symbols, but only as they illustrated his major thesis about Forster's point of view.



Forster himself dislikes the use of the term symbol, but in Aspects of the Novel he acknowledges the importance of certain stylistic devices which can be grouped under the term "expanding themes." Forster uses the term expanding to refer to the rhythmic "opening out" of the great novels, as distinguished from the simpler repetition with variation of an easier type of rhythm. The term theme covers not only the symbols which Forster expands, but other words, phrases, juxtapositions and allusions whose development affects the meaning one finds in his narration. In discussing fantasy, Forster explains his use of allusions to literary and other sources, which serve as quarries for his novels. In discussing prophecy he emphasizes the importance of close reading, with attention to the author's style--the very words he uses--in order to gain full understanding and hear the "song" or "tone of voice."

Where Angels Fear to Tread is not changed in meaning by this kind of study, but it is enriched. The title theme of "Fools rush in..." is reinforced by a play on the difference between fools and angels and by a distinction between kinds of inaction. These distinctions are part of a larger theme of paradox or the complexity of life, which Italy teaches. The hero refers to these revelations as the "new life," and Dante emerges as a literary source.

A Room with a View makes more extensive use of sources, particularly certain Renaissance paintings and two authors, Carlyle and Arnold. The title theme refers to the liberation of women, symbolized by the Birth of Venus, and also to the idea of perspective, or seeing two things in complementary relation. The relation of body to spirit and the relation of life to death are both explored, with a resolution in the affirmation symbolized by sweetness and light.

The Longest Journey makes extensive use of "quarry" themes from all history. Symbolized by the hero, Rickie, modern man is especially likened to Percival and to Amfortas in Parsifal--all obliquely through recurring allusions. The theme of man's salvation is symbolized by a photograph of the Demeter of Cnidus, whose meaning is complex and enigmatic to the end, accompanied as it is by allusions to the "racial essence," the voice, the clouded sky, the stellar hero.

Howards End is based on the inscription theme, "Only connect," which refers not only to the plot's battle of sexes and the combination of characters from different social classes, but to the reconciliation of opposites, symbolized by tidal forces, and the theme of "See life steadily and see it whole." Besides Arnold and Coleridge, Forster uses themes from theosophy and especially from Ruskin's Stones of Venice.

A Passage to India, like Whitman's poem, develops the idea of passage or unity--the unity of man and man's aspiration for unity with the Unknown. Hinduism offers a mystic solution distinguished from Mohammedanism and from the negation of the Marabar Caves. The solution is only prophetic "song," however, and part of a recurring cycle. Microfilm \$3.20; Xerox \$10.80. 245 pages.

# A COMPARATIVE STUDY OF THE SPANISH BALLAD TRANSLATIONS OF JAMES YOUNG GIBSON

(L. C. Card No. Mic 59-45)

Shasta Monroe Bryant, Ph.D.  
The University of North Carolina, 1958

Supervisor: Dr. Sterling A. Stoudemire

Although a very large number of Spanish romances have been translated into English, the only translations which are widely known are those of John Lockhart. Considered strictly as translations, however, there are many defects in the ballads of Lockhart, and there is strong reason to think that the translations of James Young Gibson are a much better representation of this branch of Spanish literature. The present study investigates this belief by analyzing one hundred and thirty of Gibson's translations, comparing them directly with the original romances and with the versions of other translators, notably Lockhart's. Since one of the problems in evaluating ballad translations is location and identification of sources, many of the original romances rendered by Gibson are placed side by side with his translation. Almost one hundred of the translations are compared in this manner. The first lines only of the other originals are included.

Over fifty translations from some fifteen other translators were also examined and compared with Gibson's work. Twenty-four of these are by Lockhart. The discussion is separated into chapters which analyze Gibson's Cid ballads; other historical ballads and Moorish ballads; and ballads of chivalry, adventure, love, and philosophy. The basic criteria used throughout are the rules of translations expressed by Alexander Fraser Tytler, Lord Woodhouselee.

The results of this study indicate that Gibson translated a greater number of Spanish ballads and of more different types than any other English translator. He used almost all of the common English ballad patterns, in addition to several of his own creation. His translations exhibit a high level of craftsmanship, are uniformly pleasing and correct, and show a scrupulous regard for fidelity to the original. In almost every case they were found to be equal, or superior, to versions of the same ballads by other translators. It would appear that Gibson should be considered a foremost translator of ballads, and his translations the most worthy examples in English of the Spanish romance.

A review of English translators and translations and a summary of Gibson's life and work precede the study of his ballad translations.

Microfilm \$4.70; Xerox \$15.80. 367 pages.

# MONTESQUIEU AND THE ABBÉ DU BOS: THEIR LITERARY RELATIONSHIP

(L. C. Card No. Mic 59-827)

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University of Colorado, 1958

Supervisor: Assistant Professor Rodolphe-Louis Hébert

The object of this thesis has been to make available to students of French literature more precise information



concerning the literary relationships between the abbé Du Bos and Montesquieu. An attempt has been made to gather together facts which have been forgotten or ignored for a long time by students of both writers, and to interpret these facts in the light of more recent scholarship wherever possible.

The study reveals no mutual influences, but shows a powerful influence exerted by the writings of Du Bos upon those of Montesquieu. This has been treated chronologically, with respect to the years in which the works which reveal the influence first appeared before the public.

Du Bos, a leading exponent of absolutism in government by monarchy, wrote an *Histoire de l'établissement de la monarchie française dans les Gaules* (1734) to refute the *Histoire de l'ancien gouvernement en France* (1729) of Count Boulainvilliers. Boulainvilliers claimed that Clovis, who founded the French Monarchy, was no more than a supreme military commander. Du Bos claimed that the descendants of Clovis were heirs to the Roman Empire in the West, by virtue of a hereditary office held by the father of Clovis, and also by virtue of a cession of powers made to his descendants by Justinian, the Emperor in the East. Thus, the French Nobility, descended from the original Frankish "invaders," are wrong to claim descent from a conquering race, since there was no conquest. They are wrong to claim that the Kings of France usurped their powers, since their powers came from the King, who had the power to recall them. Montesquieu, in his *Esprit des lois* (1748), refuted this argument. Recent scholarship, however, tends to rehabilitate Du Bos' reputation at the expense of that of Montesquieu.

Our study shows that Montesquieu borrowed freely from Du Bos' *Réflexions critiques sur la poésie et sur la peinture* (1719) for the theory of climate which he presents in the *Esprit des lois*. Montesquieu borrows numerous illustrations from Du Bos' work, and he also appropriates the unique plan which Du Bos has hit upon for classifying the phenomena he deals with. This plan consists in dividing all natural phenomena into two classes, attributed to *causes physiques* and to *causes morales*. This dual system of causation is visible in the *Esprit des lois*, in the *Considérations sur la grandeur et sur la décadence des Romains*, and even appears in the *Lettres persanes*. It is the most discussed feature of Montesquieu's thought; numerous writers have tried in vain to trace it to a source other than Montesquieu's own intellect.

Our study also reveals that Montesquieu appropriated Du Bos' most original contribution to the literature of esthetics--the notion that the esthetic emotion is necessary to human happiness because it satisfies the need of the mind to be occupied at all times. Montesquieu makes use of this basic idea, which forms the *leit-motif* of the *Réflexions critiques* in an article written for the *Encyclopédie*, *Sur le goût*, where it becomes the foundation for his system of esthetics. He uses the same idea in an article entitled *Sur le bonheur*, where it becomes the basic concept in a system of happiness. Barckhausen declares that it is essential to an understanding of the *Esprit des lois*. The two articles contain numerous illustrations drawn from, or suggested by, the *Réflexions critiques*, as shown by parallel citations in our study.

It becomes clear from this study that the abbé Du Bos exerted a great influence upon Montesquieu, hitherto suspected, but now seen to exceed all expectations. The influence is present in his writings throughout his career.

Since students of Montesquieu seem generally unaware of this influence, this research provides a new approach to the evaluation and classification of Montesquieu's basic ideas. Microfilm \$2.45; Xerox \$8.60. 188 pages.

#### THE RELATION OF BROWNING'S POETRY TO RELIGIOUS CONTROVERSY 1833-1868

(L. C. Card No. Mic 59-48)

Richard Weinberg Goldsmith, Ph.D.  
The University of North Carolina, 1958

Supervisor: Lyman A. Cotton

The purpose of this study is to examine the way in which Browning's poetry reflects religious controversy of the first four decades of his writing career. Chapter One discusses the methods used in and the assumptions made by this study. Chapter Two discusses the Church-State controversy of the 1830's and the interest in Italian literature and Dante reflected in the periodicals and concludes that these two matters may have been the intellectual matrix of *Sordello*. Chapter Three discusses the aftermath of Tract XC, Newman's entry into the Roman Church, W. G. Ward's degradation, the ritualism controversy, and the fall of O'Connell--all of which took place between 1841 and 1846--and concludes that an interest in the careers of O'Connell, Newman, and Ward may have played a part in the composition of *The Return of the Druses* and of *Luria* and *A Soul's Tragedy*, and that the contemporary interest in the ritualism controversy may be reflected in "The Bishop Orders his Tomb," "The Flight of the Duchess," and "Soliloquy of the Spanish Cloister." Chapter Four concludes that "Bishop Blougram's Apology" may be considered an answer to Cardinal Wiseman's *An Appeal to the English People*, that "Caliban upon Setebos" is a satire on Spurgeon and Cumming, two prominent Dissenting ministers, and that "Mr. Sludge the Medium" is in part a satire on Cardinal Newman's belief in nineteenth-century Roman Catholic miracles. Chapter Five concludes that *The Ring and the Book* reflects the contemporary interest in the fate of Pio Nono, the Roman Question, and also may reflect the vast amount of religious controversy generated by the publication of *Essays and Reviews* and by the Newman-Kingsley quarrel. Specifically it is suggested that the Pope's monologue reflects the controversy over Papal infallibility, that Book I may reflect controversy over Biblical inspiration and the nature of truth, and that Book XI may reflect controversy about eternal punishment. It is also suggested that Books VIII and IX satirize the ecclesiastical trials which were a prominent feature of the religious life of the 1860's and also satirize the official writing style of the Roman Catholic hierarchy. The Conclusion of this study states that the evidence that the poems dealt with reflect religious controversies is strongest in the 1850-1864 period--the period in which the findings of this study parallel the findings of numerous other scholars--and that there is sufficient evidence to suggest that Browning's poetry reflects religious controversy of the 1830's, the 1840's, and the late 1860's.

Microfilm \$4.85; Xerox \$16.20. 377 pages.



THE IMAGERY OF BYRON'S  
ROMANTIC NARRATIVES AND DRAMAS

(L. C. Card No. Mic 59-829)

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University of Colorado, 1958

Supervisor: Professor Leslie L. Lewis

The functional use of imagery in Byron's Romantic narratives and dramas is the subject of this investigation. The few existing studies of Byron's imagery deal with the images out of context or with the descriptive use of imagery--the imagistic amplification of the narrative at only one point. None concentrates on the functional use of imagery--the imagistic coordination of the narrative at two or more points.

The Giaour, The Bride of Abydos, The Corsair, Lara, The Siege of Corinth, Parisina, Manfred, Mazeppa, Cain, and The Island are the poems analyzed because they are a distinct group that delineates the flourishing and decline of the Byronic hero.

The erratic occurrence of functional imagery in these ten poems, the prominence of the imagery of fire and water, the splitting apart of the hero, and variants on the monomyth of the "culture-hero" in Manfred and Cain are the main findings of this study. Only in Manfred and Cain is the imagery functional; in The Giaour, The Corsair, Lara, Parisina, and Mazeppa, the imagery is partially functional; in The Bride of Abydos, The Siege of Corinth, and The Island, the imagery is weakly functional.

The integration of imagery and narrative is exceptional in Manfred and Cain. The overwhelming pattern of the imagery of guilt and remorse in Manfred shows why sleeplessness, the ravages of accelerated time, the damned appearance of nature, and the failure of Manfred's superhuman powers drive him to seek death. The stark imagery of trees, fruits, and serpents that dominates Cain also dominates the main action--Cain's search for the reality behind the symbol.

Since the imagery of fire and water appears in major or minor form in all ten poems, it is the chief imagistic vehicle of Byron's Romanticism. The simple dichotomy of a burning life and love and a watery death in The Giaour is not the sum of this imagery, but it is the most basic illustration.

The imagery of the Byronic hero shows him to be in varying degrees a superhuman, alienated rebel, plagued by guilt and remorse for some unknown crime, who fights valorously and loves one idealized woman. The division of the imagery of the hero between a father-figure and a youth in Parisina, Mazeppa, and The Island shows how the hero is split apart.

Manfred and Cain are variants on the monomyth that is described in Joseph Campbell's The Hero with a Thousand Faces. The image of the quest in these two poems seems the most significant in this study because of the way it reveals the marked alienation and dedication to death of Byron's Romantic hero. Manfred goes through the timeless ritual of the quest to aid no part of mankind, to appease no gods, but to salve his own pains. He is so self-centered that he is cut off from a major characteristic of the world of myth--the close interaction between hero, society, and the gods. Cain is a racial representative, but his alienation from all who worship God leaves him isolated

from his society. His trip to Hades and spurious initiation make him more antagonistic than before, and his murdering of Abel exiles him from man and God. The quest is paradoxical for Manfred and Cain because death is the boon each achieves. Instead of life-restoring heroes, they are destroying ones. Among the Byronic heroes of these ten poems, only Mazeppa and Torquil escape this blight; however, blighted as Manfred and Cain are, they move within emotionally effective poems. The structure of the quest and functional imagery make Manfred and Cain stand out as near masterpieces.

Microfilm \$2.00; Xerox \$7.00. 148 pages.

AN ANALYSIS OF LITERARY CRITICISM  
IN AMERICA BETWEEN 1899 AND 1914

(L. C. Card No. Mic 59-798)

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University of Colorado, 1958

Supervisor: Professor Paul J. Carter, Jr.

At the end of the nineteenth century American literary criticism was dominated by conservatism. Respect for the social order, conventional morality, and literary standards from the past characterized the critiques. Reviews in the periodicals consistently defended two sorts of objective criteria--literary and extra-literary--called objective because they represented pre-determined rules, applied impersonally. Literary criteria emphasized historical literary standards, a conservative attitude regarding changes in art, and detachment from actuality because art must be better than life. Extra-literary criteria required support for the social order, demanded conformity with conventional morality, and urged inductive study of art in its historical milieu. With the genteel tradition in American culture these objective principles established Traditional Criticism as the dominant theory.

A subjective theory, known as impressionism, was recognized but its proponents were relatively few. For the most part they supported impressionistic criticism by requesting that the critic be more personal in his decisions. In reviews at the turn of the century, four principles of subjectivism were implicit. Foremost was the belief that critics should focus primary attention on the individual piece of art rather than historical standards usually assumed to govern it. A second principle logically followed, that the critic evaluates the individual work by means of intuitive, not acquired, taste. A third mark of impressionism, barely hinted at the time, was the assertion that criticism and creation are one, that the critic creates as he evaluates. Finally, the subjective nature of impressionism was revealed by numerous demands that the critic test art by empirical means, that is, that he measure it against life rather than past art. As a serious form of criticism, however, impressionism was unpopular in reviews at the turn of the century, most critics assuming that it was their task to shape literature according to approved patterns of the past. Yet a decade had scarcely passed until subjective criticism virtually replaced traditional criticism in the magazines. How this change came about provides the object of this investigation.



The change from objective to subjective criteria, startling in its rapidity, came about when critical standards lost their potency. First attack by the impressionists fell upon literary standards. Although these standards were never wholly surrendered, the loss of critical authority which followed was responsible for significant results. The traditional attitudes of conservatism and detachment disappeared from the reviews early in the century. Concurrently, demands for a pragmatic test of art were undermining all objective standards. Social idealism, manifested previously in demands that art support a stable social order, thus vanished as the critics turned to realistic portrayals of contemporary life. Historical criticism, never widely adopted, lost favor with other objective standards: in attempting to make criticism a science, it ran counter to the trend toward personal opinion -- the essence of impressionism. After 1903 comparative criticism, as it was then called, dwindled to a minor role in American theory. The most significant result of the overthrow of standards, however, was the reversal of attitudes toward morality in art. Although traditionalists defended the prescriptive moral standard vigorously, conventional morality lost its place at the head of objective criteria between 1899 and 1914. As authoritative standards crumbled and the truthful portrayal of life became the dominant criterion, critical evaluation passed from ethical to artistic grounds. Truth became morality. After about 1910 the restrictive moral code practically disappeared; in its place appeared critical pragmatism with art for life's sake as its motto. Thus the fifteen years between the Spanish-American War and World War I witnessed a significant change in criticism -- from the traditional emphasis on objective criteria to the impressionistic emphasis on subjective response.

Microfilm \$4.75; Xerox \$16.00. 371 pages.

#### A CRITICAL AND ANNOTATED EDITION OF LOPE DE VEGA'S LA VILLANA DE GETAFE

(L. C. Card No. Mic 59-717)

Gunda Sabina Kaiser, Ph.D.  
The University of Wisconsin, 1959

Supervisor: Professor Everett W. Hesse

La Villana de Getafe has been edited several times since its first printing in the Parte Catorce of 1620, but it has only been treated in a semi-critical fashion. The object of this dissertation is to provide an edition of the play with an introduction, a reliable text and adequate annotation. The variant readings of the editions are also recorded.

The commentary on the text is given in great detail in order to explain obscure words ordinarily not found or fully defined in a dictionary, and to elucidate mythological references and other allusions. Occasional prose readings and translations have been included to facilitate comprehension of the play.

The Introduction is comprised of eight chapters. Although no autograph manuscript is known to exist, two copies of the play were published in the seventeenth century, and three in the twentieth century. The first chapter

comments on the known editions of the play, and indicates their present location.

Chapter II discusses the date of composition of the text. The title is given in the second Peregrino list of 1618, but not in that of 1604. References to the expulsion of the moriscos place the terminus a quo after 1609. Documentary sources and internal evidence indicate that the terminus ad quem is not as late as 1618, for papers from the Archives at Toledo show that the play was written by January 26, 1615. Although a number of critics favor early 1613, I date it some time late in 1613 or early 1614 from evidence found in Lope's correspondence with the Duke of Sessa.

The third chapter discusses the essential details of the plot, and Chapter IV treats of the possible autobiographical references in the character names.

The first part of Chapter V presents the previous criticism of the play. The second part analyzes the play in regard to plot structure, characters, language, comic element, versification, and concluding remarks.

Chapter VI discusses the distribution of verse forms by Acts and percentages, whereas Chapter VII presents some observations on disguise in the Golden Age.

Chapter VIII comments on the Dedication of the play which is, in reality, a defense by Lope of his own sonnet that was criticized negatively by a number of the members of a literary academy. Lope dedicated the play to his friend López de Aguilar, who was a strong defender of the Fénix in the Expostulatio Spongiae, an answer to the attack against Lope's style in the Spongia by Pedro de Torres Rámila and others. The Dedication was probably written between September-October, 1619. A section devoted to notes which elucidate unusual terminology, allusions, and content matter found in the text of the Dedication concludes this Chapter.

The life of Pedro de Valdés, autor and that of his wife Jerónima de Burgos is included in the Appendix. Jerónima, Lope's mistress for a time, secured the dramatist's authorization for her husband to produce several of his plays in which she usually played the leading role. Lope most likely presented her with La Villana de Getafe.

The eternal theme of love, the rapid action with its fascinating intrigue, the comic element, the sparkling dialogue, the naturalness of thought and speech, the picturesque songs and dances, the facile verses, the absence of melodramatic and incredible situations, the lack of stress on the artificial honor code, and finally man's desire to improve his social position through his own capacities will continue to make La Villana de Getafe a refreshing and enjoyable experience to the spectator and the reader. La Villana de Getafe deserves a wider reading public than it has hitherto enjoyed, for it is one of Lope de Vega's better plays.

Microfilm \$6.15; Xerox \$21.80. 484 pages.

#### BYRON'S USE OF GOTHICISM

(L. C. Card No. Mic 58-5154)

Samuel Cathcart Ketchin, Ph.D.  
Emory University, 1957

The influence of the Gothic tradition, obvious in the works of all the major Romantic poets, is most apparent



in the poetry of Lord Byron. Utilizing Gothic materials throughout his career, Byron varied his handling of Gothic matter according to the demands of genre and according to his aesthetic purpose. But every genre in which he wrote and every subject he treated are colored by Gothic mood. His adaptations of Gothic prototypes of character, setting, and plot constitute an important aspect of his distinctive expression of romantic aspiration. Indeed, Gothicism explains significantly the quality known as Byronism.

Consideration of Byron's poetry in terms of the three major Gothic moods--those of terror, horror, and the elegiac--leads to certain suggestive conclusions about the poet's temperament, his technique, and his philosophy. A number of the shorter poems, for example, suggest that Byron interpreted his personality in terms of a combination of the villain of the tale of terror and the suffering poet of eighteenth-century elegies. Further, the metrical tales exhibit Gothic characterization, setting, and plot. Thus, the Byronic hero, developed in the early tales, is a refinement of the Gothic villain, and setting often arouses suspense and terror. Although none of the metrical tales has a typically Gothic structure, such motifs as incest and revenge are conspicuous.

The moods of terror and the elegiac account significantly for the tone of *Childe Harold's Pilgrimage*. Harold blends the Gothic villain with the elegiac poet, and typical Gothic features of the setting echo the mood of the hero, sustaining the gloomy spirituality that pervades the poem. Gothic material also plays an important part in *Manfred*, as well as in Byron's other dramas. *Manfred* displays many characteristics of the villain, and the setting of the play is typical. Employing Gothic motifs of incest and the supernatural, the plot builds simply to a single climax with a concentration appropriate to the tragic stature of *Manfred's* character. The seriousness of purpose that characterizes *Manfred* is also evident in most of the other dramas. Here, the poet's handling of setting and Gothic plot motifs is more important than characterization in evoking an atmosphere of eeriness and foreboding.

Byron's treatment of Gothicism in *Don Juan* and *Beppo* is sometimes serious, sometimes humorous. The poet parodies certain stereotyped plot motifs and situations, but he also introduces passages of elegiac meditation similar to those in *Childe Harold*.

Byron's most significant adaptation of Gothic material is his creation of heroes combining qualities of the Gothic villain and of the suffering poet of eighteenth-century elegies. These heroes exist within the Gothic tradition, and their characters account for one of the most conspicuous aspects of Byronism. Byron generally discarded complex Gothic plots and, eliminating sensationalism for its own sake, frequently utilized Gothic motifs to express a number of his most cherished convictions. Themes common to graveyard-prospect poetry recur, and the poet encourages transcendental perception of the profound implications of natural grandeur. The personality of the Byronic hero dominates such passages and is Byron's principal innovation in adapting elegiac mood to his individual needs. The Gothic materials with which Byron worked are hardly different from those of other writers; but his alterations were important in creating Byronism. To the Gothic tradition he owed much of the distinctiveness of his work. Microfilm \$3.10; Xerox \$10.60. 237 pages.

# THE CLASH AND THE FUSION OF MEDIEVAL AND RENAISSANCE ELEMENTS IN CHAUCER'S *TROILUS*

(L. C. Card No. Mic 58-5161)

Eleanor Maxine MacKay, Ph.D.  
Emory University, 1958

Chaucerian scholars disagree sharply in characterizing the *Troilus*. Their isolation of various genres is a critical dichotomy grouped around Lewis's interpretation of the poem as "a wholly medieval romance" and Kittredge's description of it as our "first psychological novel." Because a poem of the late fourteenth century can be both medieval and modern, this study seeks harmonious synthesis of the disparate opinions.

What is essentially "medieval," or "modern," in a literary reflection of customs and ideas? The answer requires a close look at the poet's milieu and an allegiance to no special school of criticism. Such a humanistic approach runs into views among historians extending the traditional, "Burckhardtian" Renaissance into the twelfth, thirteenth, and fourteenth centuries, or discovering medieval traits in the sixteenth and seventeenth. Review of social and artistic trends isolates as essential yardsticks of analogy the medieval emphasis upon ideal type and the Renaissance stress of literal particularity.

Analysis of the relationship of *Troilus* to fourteenth-century courtly protocol and churchly precept notes that Chaucer's audience influenced characterization and substance and fostered stylistic immediacy. Examination of aristocratic ideals suggests that courtliness was a society game and that so-called "courtly love conventions" delineated by modern writers were probably not those of the twelfth or later centuries. Distinct from the northern *trouvère*, mystic Provençal traditions, which filtered through Sicily and Italy, are the chief courtly ingredients. In modification of medieval trend, *Troilus* reflects French valentine-metaphor extrinsically and classic "natural love" intrinsically.

Critics claim that the rhetorical style is evidence *per se* of the medieval quality of the poem. While it is true that Chaucer utilizes the medieval rhetorical style, he goes far beyond his predecessors in ridiculing grammatical excesses--turns this style into a new poetic art that successfully reunites form and context. A skilled with knowledge of the *trecento* ideal expressed in Boccaccio's poetic manifesto, he applies rhetorical principles substantively, in contrast to the medieval use of them as stylistic ornament. His studied emulation of Latin writers is humanistic.

Chaucer's characters express the classic, threefold nature of man in their internal conflicts of sensory, rational, and moral levels of being. This war is presented in literal scene and realistic inner monologue, Renaissance in tone. Each protagonist also represents allegorically one aspect of the threefold nature, through a medieval, external dramatization. Thus Criseyde is the sensory, Pandarus the rational, and *Troilus* the moral nature. Relating threefold characterization to threefold meaning, Chaucer creates literal, allegorical, and tropological (moral) levels of meaning. The moral suggests that *Troilus* violates Neoplatonic "natural love." His exaggerated adoration of his lady fails to make the progression from senses to intellectual union with deity that was recommended



by classic, medieval, and Renaissance philosophies. The literal has weighted, Renaissance stress because Chaucer's *Troilus* examines various forms of love and seeks legitimate place for human love within sanctions of the divine.

This study concludes that a quarrel about genres adds nothing to the interpretation of meaning. *Troilus* is not a medieval romance of martial adventure, faithful love, and happy ending. Containing themes and techniques like those of Renaissance drama or modern novel and fabliau-realism juxtaposed with epic embellishment, it is--as Chaucer says--a tragedy. It is a tragedy that clearly anticipates the poetry of Shakespeare's century. The scholars' interpretations emphasize one layer of meaning to the neglect of the others, thus suggesting personal enthusiasms of critical focus. No one interpretation appears exclusively correct or exclusively erroneous. More in the manner of the Elizabethans than in the mood of the romancers, the *Troilus* expresses a clash and a fusion of medieval and Renaissance literary art.

Microfilm \$8.25; Xerox \$28.40. 650 pages.

#### THE PRIMARY PERSONALITY TRAITS OF RIMBAUD

(L. C. Card No. Mic 59-545)

Jay Paul Minn, Ph.D.  
University of Illinois, 1958

Rimbaud's life and works are studied in an attempt to delineate his basic personality. The critics largely concede the poet's outstanding personality trait to be that of revolt. However, this concept does not imply sufficiently the unity of Rimbaud.

A chronological analysis is made of Rimbaud's life and works by utilizing a basic cluster of traits: revolt (as expressed by Dr. Louis Auvinet), flight, and submission (as expressed by M. Pierre Debray). This pattern is applied to Rimbaud in reference to his parents, particularly his mother and her social dictum. *Bateau ivre* is found to be the prototypic expression of the cyclic pattern which repeats itself through his lifetime.

In conjunction with the study of Rimbaud's thought, sun images are traced in his poetry. *Barbare* (*Les Illuminations*) is interpreted as a climax to the development of these images. The traditional dating (1872-1873) of *Les Illuminations* is not followed, although it is possible that some of the poems may have been written in that period. In continuation of the work of M. Henri de Bouillane de Lacoste, *Barbare* is dated after August, 1873 (completion of *Une Saison en enfer*) because its key symbolism is found to derive from Flaubert's *Tentation de saint Antoine* (April, 1874). The poem is interpreted as a carefully written "twilight" state between dream and reality. *Villes I* ("Ce sont des villes! ...") and possibly *Aube* also appear to contain reminiscences of Flaubert's novel. *Vingt ans* and *Sonnet* are dated in 1874-1875 from an analysis of Rimbaud's attitude toward his age in comparison with a similar attitude in his works.

Microfilm \$4.10; Xerox \$13.80. 317 pages.

#### THE ROMANTIC HERO IN FRANCE

(L. C. Card No. Mic 58-5174)

George Ross Ridge, Ph.D.  
Emory University, 1958

The romantic hero is the touchstone to understanding the romantic movement in France. He incarnates the spirit of a cataclysmic age which was marked by revolution, by the disintegration of hierarchy, by industrialization, by scientific and technological progress, by new philosophical and ethical orientation. He interprets life and society according to his radically different set of values. But although he reflects a fundamental change in worldview, the romantic hero has never been studied at length.

This thesis is a pilot study rather than an exhaustive record of the romantic hero's appearance in French literature. Principles are the ultimate concern, and romantic documents are valuable primarily as illustrative material. The main sources of this investigation are appropriate works of Chateaubriand, Constant, S  nancour, Lamartine, Vigny, Musset, Hugo, Balzac, Dumas p  re, Stendhal, Barbey d'Aureville, Nerval, and Baudelaire, or from the appearance of *Le G  nie du christianisme* in 1802 to *Les Fleurs du mal* in 1857. The purpose of the study is to establish who the romantic hero was, to investigate the forces which molded him, and to ascertain how he reflected the romantic worldview.

The romantic hero may be defined as the male protagonist in romantic literature. He appears under a number of guises, but the different romantic heroes all belong to the same fundamental type. They are all descended from the archetypal self-conscious hero, who is characterized by acute awareness of himself and by his romantic sensibility. The self-conscious hero becomes a particular kind of romantic hero by responding differently to the social and cosmic contexts in which he moves. In general he may assume one of five roles or a pseudo-role. According to the way in which he expresses his romantic self-consciousness, he may be a seeker, a man of fate, a pathological hero, a poet-prophet, or a rebel. By assuming the pseudo-role, he becomes the anti-hero, a protagonist who is potentially heroic but who employs his romantic self-consciousness to comment ironically upon his own weaknesses. These are the principal lines of descent from the archetype, the self-conscious hero, but the lines are not always clearly separated. Certain heroes are actually a fusion of the different roles, and a romantic hero may be, for example, a seeker and a rebel at the same time. But whatever role he may assume, he remains fundamentally the self-conscious hero.

The romantic hero reflects a concern with the problems of the age. As the seeker, he tries to formulate new values. As the man of fate, he copes with a mechanistic universe. As a pathological hero, he comes to a new understanding of normalcy and hypersensibility. As the poet-prophet, he establishes the poet's place in the new society. As the rebel, he shatters the old code of values to replace it with a new code. As the anti-hero, he may despair of solving the many problems inherent in the formulation of the romantic worldview. It is therefore natural that a self-conscious age, which questions traditional values and tests the new, should find its literary expression in the self-conscious hero--the romantic hero.

Microfilm \$3.50; Xerox \$11.80. 270 pages.



# THE REPUTATION OF ARNOLD BENNETT OVER A HALF CENTURY

(L. C. Card No. Mic 59-1294)

Thomas John Roberts, Ph.D.  
University of Minnesota, 1958

Even though Georgian novelists tended to disparage them in the course of a general rejection of all the Edwardians, during his lifetime Arnold Bennett's novels were taken very seriously by even the most demanding of critics. However, after his death readers lost interest in such fine novels as *Anna of the Five Towns*, *Clayhanger*, *The Pretty Lady*, and *Riceyman Steps*. Perhaps only *The Old Wives' Tale* has received any part of the respect it deserves.

This indifference has been the product of at least two causes: (1) readers have sympathized with the Georgians' attitudes and have consequently been unsympathetic towards Bennett; and (2) readers soon became better equipped to read Georgian novels than they were to read Bennett's. However, English fiction is closer now to the Edwardian tradition, and both readers and writers are beginning to show a new interest.

A study of the Georgian rejection of Bennett, as it appears most typically in Virginia Woolf, shows that it was felt that he could not create convincing characterizations and that he was suspected, with Wells and Galsworthy, of being a propagandistic novelist. The second of these criticisms is invalid; Bennett rarely attempts to move his readers to social action. The former criticism is also unjust and has resulted merely from the fact that Bennett employed different (because more traditional) techniques than the Georgians used.

A study of Bennett's novels suggests some differences between him and other novelists and some reasons for his striking achievements. Each of the three genres into which his novels are most conveniently grouped reveals a somewhat different facet of Bennett's craft and artistic imagination. His melodramas reveal that he had great difficulty avoiding the vision of reality most characteristic of the realistic novels and that a few patterns and types seem to have dominated his imagination; moreover, they give a good insight into his highly developed sense of form. His farces indicate most clearly his moral response to English life of the period. In his realistic novels, Bennett managed to achieve not only a painfully honest and consistent vision of reality but also a characteristically mature adjustment to it.

Though he has often been accused of too great a concern with inert facts, a study of descriptive passages makes it plain that he employed them for characterization. Throughout his career he devoted much time to fashioning and re-fashioning a few basic types of characters (most of them can be grouped into one or another of seven basic types) and to certain typical scenes--especially a long illness and painful death. His irony is so pervasive and sometimes so subtle that many of his readers have missed it. Sparing neither his characters, his readers, nor himself, he offers a sensitive and often profound commentary on society and on conventional attitudes toward human life, and he employs his irony as a device to suggest larger views of reality than he could have permitted to the characters he portrayed. Such techniques in characterization and description and the use of irony help to explain why his best books are so memorable.

Finally, a comparison of Bennett's novels with those of Virginia Woolf shows that while Mrs. Woolf's characters are finer in conception, Bennett's are more massive and more monumental. Much the same contrast obtains when the whole novels of these writers are compared. As younger writers and readers devote more time to the study of his novels, the monumental qualities of Bennett's fiction will perhaps become more widely known and a more just assessment of his stature effected.

Microfilm \$3.05; Xerox \$10.60. 236 pages.

# JEWISH STEREOTYPES IN ENGLISH FICTION: 1795-1895

(L. C. Card No. Mic 59-283)

Edgar Rosenberg, Ph.D.  
Stanford University, 1958

The purpose of the dissertation is to examine a number of Jewish stereotypes in the nineteenth-century English novel; to relate them to their prototypes in earlier English literature; and to analyze them in the framework of the novels in which they appear. The study is concerned less with social and historical currents than with the persistence of Jewish types within a continuous literary tradition. It will be found that throughout the nineteenth century two extreme types, neither of them original, flourished side by side: on one hand, the Jewish criminal, derived from the New Testamental and medieval conceptions of the Jew as religious bogey, mutilator, and parasite; on the other hand, the Jewish paragon, a product of the eighteenth-century sentimental vogue. Where the Jewish villain has functioned as a dramatically powerful caricature, compounded of horrific and ludicrous elements, the idealized Jew has often been little more than a spokesman for the author's didactic intentions and an all too obvious apologist for his race. Frequently the portrayal of the criminal directly determined the portrayal of his antipode: since the one figured as a monster of commercial rascality, whose boundless egoism placed him beyond the social limits, the other appeared as a paragon of commercial probity, whose humanitarian sympathies suggested that he had been placed beyond the communal limits unfairly.

The nineteenth-century novel has perhaps contributed more conspicuously to a permanent mythology of the Jew than any period or genre since the Renaissance drama. Maria Edgeworth, at the beginning of the century, used both good and bad Jews as exemplary figures in her didactic fiction. Scott's Isaac of York reconciles the extreme types, functioning at once as the persecuted outcast, a victim of historical pressures, and as the time-honored usurer and comic butt. Dickens's Fagin represents a throwback to the archetypal medieval bogey, divested of his religion and his wealth. The Jewish parasite, operating at the highest level of economic success, reappears in the vulgar monopolists and upstarts to be found in the novels of Trollope and Bulwer. In Eliot's *Daniel Deronda* the tradition of the impeccable Jew is joined to a new concern for the political future of the Jews. In Edgeworth's *Bertrice*, Scott's *Rebecca*, and Eliot's *Mirah*, the myth of the Jew's daughter finds a variety of solutions.

I conclude the study by examining the independent legend



of the Wandering Jew, especially as it devolved on the Gothic novelists and as it emerged, at the end of the century, in Du Maurier's Trilby.

Microfilm \$5.40; Xerox \$19.00. 423 pages.

**THE ACADEMIA ESPAÑOLA AND THE  
CORRESPONDING ACADEMIES IN  
SPANISH AMERICA, 1870 TO 1956**

(L. C. Card No. Mic 59-58)

Edward Davis Terry, Ph.D.  
The University of North Carolina, 1958

Supervisor: Sturgis E. Leavitt

The Spanish Academy was established in 1713 and almost immediately took an interest in scholarly endeavor in America. It elected three honorary members from Spanish America as early as 1739. This interest continued over the years, but the Spanish Academy had no systematic policy with regard to the Americans until past the middle of the nineteenth century. In 1870 it resolved to organize corresponding language academies in Hispanic America.

The efforts of the Spanish Academy to found academies were received enthusiastically by some countries, but met with indifference in others. The Colombians organized their academy in 1871. Ecuador, Mexico, and El Salvador founded their academies in 1875. Soon afterwards four other countries founded academies: Venezuela in 1883, Chile in 1886, Peru in 1887, and Guatemala in 1888. Some of these academies disappeared almost immediately. In the twentieth century academies were founded, died out,

and were reorganized. The last academy founded was in Puerto Rico in 1952. The corresponding academy in Argentina, which was active from 1910 to 1914, was replaced by the Academia Argentina de Letras. Uruguay followed the example of Argentina and organized an Academia Nacional de Letras.

The young American academies met with many obstacles. Lack of financial resources bothered most of them, especially in the field of publication. Occasionally governments would offer financial aid, but would not live up to the promise. Political upheavals caused several academies to become inactive. A few disappeared because of the death of key members. An exaggerated sense of nationalism seems to have eliminated two of the "academias correspondientes." However, in spite of difficulties the American academies have been successful in keeping the public interested in literary and language activities. The academies in Colombia and Venezuela have been active in publication and in holding literary contests.

A Congress of Academies of the Spanish Language was held in Mexico City in 1951. This Congress was sponsored by Miguel Alemán, President of Mexico, and was financed by the Mexican government. All the language academies in America and the Philippine Academy sent delegates. The Spanish Academy was prevented from attending by pressure from the Spanish government.

In 1956 a second Congress of Academies met in Madrid with the Spanish Academy as host. Delegates from all twenty of the language academies were present. The Spanish government paid the expenses involved in holding this second Congress. It was the first time the Spanish Academy, the American Academies, and the Philippine Academy had met together.

Microfilm \$3.15; Xerox \$10.80. 242 pages.



## MATHEMATICS

### SCATTERING OF SURFACE WAVES ON AN INFINITELY DEEP FLUID

(L. C. Card No. Mic 59-251)

James Edward Burke, Ph.D.  
Stanford University, 1958

The scattering of gravity waves on an ideal incompressible fluid is investigated. Emphasis is placed on the case of a train of infinitesimal time harmonic surface waves incident on a rigid submerged plane barrier, with a finite width, placed parallel to the free surface of the fluid. Within the framework of the small amplitude theory the description of the resulting fluid motion is a classical potential theory problem. It is assumed that the propagation normal of the wave motion is oblique to the edge of the barrier (that is the velocity potential has a harmonic dependence on the coordinate parallel to the edge of the barrier), and thus only two dimensional considerations are required.

Employing Green's function procedures, the velocity potential is represented in terms of its discontinuity (pressure difference) across the barrier. The requirement that the normal fluid velocity vanishes at the barrier leads to a one dimensional integral equation for the pressure difference. This equation is extended by introducing the fluid velocity normal to the plane of the barrier, and the associated Fourier transform relation is analyzed by the methods of Wiener and Hopf.

The transforms relating to the normal velocities are found to be characterized by a pair of dual inhomogeneous integral equations which allow systematic approximation by iteration. The velocity potential is then expressed in terms of these transforms, and a complete scheme is thereby presented for determining the fluid motion anywhere. The analogous pairs of integral equations for a vibrating plate below the free surface of the fluid, and a finite dock, are also obtained. The reflection and transmission properties for the submerged rigid barrier are investigated, and explicit calculations are made for a barrier width large compared to wave lengths.

Microfilm \$2.00; Xerox \$4.00. 71 pages.

### CHARACTERIZATIONS OF RIEMANN $n$ -SPHERES

(L. C. Card No. Mic 59-879)

George Franklin Feeman, Ph.D.  
Lehigh University, 1958

In 1899 Liebmann proved that in ordinary Euclidean space  $E^3$  a closed surface with constant Gaussian curvature is a sphere. For this theorem D. Hilbert [Grundlagen der Geometrie, 7th edition, Leipzig and Berlin, 1930, pp. 231-240] gave an ingenious proof, which now supersedes the original one given by Liebmann. It is also well known that in the space  $E^3$  a closed convex surface with constant

mean curvature is a sphere. These theorems were extended by W. Süss [Tôhoku Mathematical Journal, vol. 31 (1929), pp. 202-209] to convex hypersurfaces in a Euclidean space  $E^n$  of dimension  $n \geq 3$ . Recently, C. C. Hsiung [Mathematica Scandinavica, vol. 2 (1954), pp. 286-294; Pacific Journal of Mathematics, vol. 6 (1956), pp. 291-299] has extended the results of Süss to a class of hypersurfaces, satisfying a condition weaker than convexity, imbedded in a space  $E^n$  as well as in an  $n$ -dimensional Riemannian manifold of constant Riemannian curvature. The purpose of this paper is to use a new method to complete the latter case of Hsiung's work and to study a more general case in which hypersurfaces are imbedded in a general Riemannian manifold of dimension  $\geq 3$ .

Let  $V^n$  ( $n \geq 2$ ) be an  $n$ -dimensional orientable hypersurface of class  $C^3$  with boundary  $V^{n-1}$  of dimension  $n-1$  imbedded in a contractible region of a Riemannian manifold  $V^{n+1}$  of dimension  $n+1$  and constant Riemannian curvature. At first,  $n$  integral formulas for  $V^n$  are derived, and then some conditions on the mean curvatures  $M_\alpha$  ( $\alpha=1, \dots, n$ ) of a closed hypersurface  $V^n$  are deduced for  $V^n$  to be a Riemann  $n$ -sphere, that is, for every point of  $V^n$  to be umbilical with respect to the manifold  $V^{n+1}$ . Similar results are also obtained for a closed hypersurface  $V^n$  imbedded in a general Riemannian manifold  $V^{n+1}$ . However, not all results for  $V^{n+1}$  with constant Riemannian curvature are special cases of those for a general manifold  $V^{n+1}$ .

As conclusion of this paper, by the same method as that used in the preceding sections, a new proof is given for the uniqueness theorem of Hsiung [Transactions of the American Mathematical Society, vol. 81 (1956), pp. 243-252] for Christoffel's problem for hypersurfaces  $V^n$  with boundary imbedded in a Euclidean space  $E^{n+1}$  of dimension  $n+1 \geq 3$ . Microfilm \$2.00; Xerox \$3.00. 54 pages.

### THREE THEOREMS IN DIMENSION THEORY

(L. C. Card No. Mic 59-997)

Auguste Forge, Ph.D.  
Duke University, 1959

Supervisor: John H. Roberts

This thesis deals with three theorems in dimension theory.

Theorem I states: Suppose  $X$  is a separable metric space of dimension  $\leq n$  and  $f_1, f_2, \dots$  a sequence of continuous functions from  $X$  into  $I$ . Then there exists a compactification  $X^*$  of  $X$  such that (1)  $\dim X^* \leq n$  and (2) there exists a sequence of continuous functions  $f_1^*, f_2^*, \dots$  from  $X^*$  into  $I$  such that  $f_i^*$  is an extension of  $f_i$ .

To prove Theorem I we construct a new totally bounded metric for  $X$  equivalent to the original metric such that the completion of  $X$  with this metric has the desired properties. We construct this new metric in two steps. First,



we get a metric that has property (2) then, we alter this metric to get a metric having properties (1) and (2).

Theorem II states: If  $M$  is a Peano continuum of dimension  $n$  such that no zero-dimensional  $F$  set of  $M$  separates a connected subset of  $M$  then there exists a continuous mapping  $f$  from  $I$  onto  $M$  such that for  $y \in M$ ,  $f^{-1}(y)$  contains no more than  $n+1$  points. Furthermore, the set of mappings with this property is a dense  $G_\delta$ -set in the space of all continuous functions from  $I$  onto  $M$ , equipped with the topology of uniform convergence.

This theorem is a partial converse to one proved by Hurewicz which says that if  $X$  is a Peano continuum of dimension  $n$  and  $f$  is a continuous mapping from  $I$  onto  $X$  then there exists a  $y \in X$  such that  $f^{-1}(y)$  contains at least  $n+1$  points. In proving our theorem we make use of another theorem of Hurewicz which says that a compact metric space  $X$  is of dimension  $\leq n$  if and only if there exists a compact zero-dimensional set  $C$  and a continuous mapping  $f$  such that  $f(C) = X$  and for every  $x \in X$ ,  $f^{-1}(x)$  contains at most  $n+1$  points.

Theorem III states: If  $f$  is a real-valued function defined on the set of all finite dimensional separable metric spaces and  $f$  satisfies Menger's axioms, then for every  $X$ ,  $f(X) \leq \dim X$ .

An axiomatization of dimension means a system  $S$  of axioms concerning a real-valued function  $f$  defined on all finite dimensional separable metric spaces such that if  $f$  satisfies  $S$  then  $f(X) = \dim X$  all finite dimensional separable metric  $X$ . Menger proved that if a function defined on subsets of the Euclidean plane satisfies his axioms then it coincides with the dimension function for subsets of the plane. His system is

1. If  $M \subset N$ , then  $f(M) \leq f(N)$
2. If  $M$  and  $N$  are homeomorphic, then  $f(M) = f(N)$
3. If  $M = \bigcup_{i=1}^{\infty} A_i$ , where each  $A_i$  is closed in  $M$  and  $\sup_i f(A_i) < \infty$ , then  $f(M) = \max_i f(A_i)$
4. For every  $M$ , there exists a compact  $M'$  such that  $M'$  contains a homeomorphic copy of  $M$  and  $f(M) = f(M')$
5.  $f(I_n) = n$ .

Microfilm \$2.00; Xerox \$3.00. 27 pages.

#### ON THE CONSTRUCTION OF A CLASS OF ERROR-CORRECTING BINARY SIGNALING CODES

(L. C. Card No. Mic 59-51)

Roy Raymond Kuebler, Jr., Ph.D.  
The University of North Carolina, 1958

Supervisor: R. C. Bose

The construction of binary signaling group alphabets is studied, where the group alphabet is the one introduced by Slepian [David Slepian: "A class of binary signaling alphabets," *The Bell System Technical Journal*, Vol. 35 (1956), pp. 203-234]. The "letters" of the alphabet are  $2^k$   $n$ -place binary sequences which form a subgroup of the group of  $2^n$   $n$ -place binary sequences, the group operation being vector addition, modulo 2, of sequences. With the weight of a binary sequence defined as the number of unities in the sequence, the probability that the detector will correctly

announce a transmitted letter is a certain function of  $p$ , the probability that a binary digit will be incorrectly transmitted, and of the weights of the coset leaders  $L_j$ , and the function exhibits the fact that the probability of correct announcement decreases as the weights of coset leaders increase.

An algebra and a geometry of binary sequences are developed. The algebra is a commutative ring algebra whose elements are the  $2^n$  distinct binary sequences of length  $n$ . The geometry employs two fundamental spaces: a topological space  $\Omega$  consisting of  $n$  distinct points  $Y_1, Y_2, \dots, Y_n$ , where the point  $Y_i$  is considered to correspond to the  $i$ -th position in an  $n$ -place binary sequence; and the finite projective space  $PG(k-1, 2)$ , from whose points the  $Y_i$ 's are selected. Each binary sequence  $T_j$  corresponds to a unique subset of  $\Omega$ , namely, the subset of those positions which are occupied by unity in  $T_j$ . Each of the  $2^k - 1$  non-null letters of the alphabet is shown to correspond to a unique  $\Omega$ -subset whose points are those lying outside a certain  $(k-2)$ -flat in  $PG(k-1, 2)$ .

Since the points of  $\Omega$  are selected from the points of  $PG(k-1, 2)$ ,  $\Omega$  is determined, to within ordering of points, by the assignment of measures  $n_i$  to the points  $P_i$  of  $PG(k-1, 2)$ , where  $n_i$  is the number of times  $P_i$  appears in  $\Omega$ , and  $\sum n_i = n$ .  $W$  is defined as the greatest integer such that all weight- $W$  sequences can serve as coset leaders;  $W$  is the integer such that the Slepian detector will correct all  $W$ -tuple (and lower-order multiple) errors in transmission. It is shown that, for given  $W$ , the distribution of  $n$ -measure over the points of  $PG(k-1, 2)$  is equivalent to the distribution of a certain measure, termed the  $D$ -measure, over the  $(k-2)$ -flats of  $PG(k-1, 2)$ , and there are derived the necessary and sufficient conditions that a  $D$ -measure define a group alphabet which will admit the correction of all  $W$ -tuple transmission errors. These conditions include a certain congruence condition on the  $d_j$ 's composing the  $D$ -measure; other congruence conditions which are necessary are also treated.

From the class of alphabet designs in which all sequences of weight  $W$  are preserved as coset leaders, selection as optimum is made of that design (or those designs) for which  $\Delta$  is minimum, where  $\Delta$  is defined as the number of weight- $(W+1)$  sequences appearing as other than coset leader. There is developed a formula which gives the value of  $\Delta$  for any given  $D$ -measure.

The problem of constructing the  $D$ -measure is treated, taking into account the necessary congruence conditions, and employing a decomposition of the  $D$ -measure into component  $D_\alpha$ -measures,  $\alpha = 1, 2, \dots, k-1$ . The case  $k=3$  is quickly resolved, and the considerably more complicated analysis for  $k=4$  is carried out in detail. With reference to the determination of  $W$ , it is shown that, for a given  $k$ ,  $W$  is a monotonically nondecreasing function of  $n$ , and  $n$  a monotonically increasing function of  $W$ . The exact relation is obtained for  $k=3$  and  $k=4$ .

Finally, the results are applied to produce catalogs of optimum alphabet designs for the cases  $k = 2, 3$ , and  $4$ .

Microfilm \$2.40; Xerox \$8.40. 183 pages.



UTILIZATION OF CHROMOSOMES  
IN QUANTITATIVE INHERITANCE

(L. C. Card No. Mic 58-7982)

Harley Ellsworth McKean, Ph.D.  
Purdue University, 1958

Major Professor: Virgil L. Anderson

Let  $\Omega$  be a natural diploid population whose members have  $K$  pairs of chromosomes and which satisfies the following assumptions:

- Genetic equilibrium under random mating.
- No selection or mutation.
- Balance with respect to linkage.
- No multiple alleles.
- Gene frequency  $\frac{1}{2}$ .
- Additivity of environmental effects and genotypic values.

It is proposed to evolve a new method of studying the mechanisms of gene action in  $\Omega$ . Specifically, it is desired to obtain estimates of the components of genetic variance, for especially in them is contained information which can theoretically be utilized in setting up breeding plans or selection experiments. In addition the geneticist can infer from them the interrelationship among the genes coming to bear upon a specific trait. It is hoped that the specific findings of this dissertation can be extended to more general situations in future work.

Let  $a_{ij,2}$  denote the genotype with two "plus" alleles at locus  $j$  of chromosome  $i$ , where  $i = 1, \dots, K$  and  $j = 1, \dots, n_i$ . Individuals with this genotype are also said to be in phase 2 at locus  $(i,j)$ , so that the phase number refers to the number of "plus" alleles at the locus. Hence  $a_{ij,1}$  and  $a_{ij,0}$  are phase 1 and 0 genotypes, respectively. Consequently if  $f_{ij}$  represents the phase at locus  $(i,j)$ , the genotype of an arbitrary individual from  $\Omega$  can be represented as  $a_{11,f_{11}} a_{12,f_{12}} \dots a_{Kn_K,f_{Kn_K}}$ .

Kempthorne's<sup>†</sup> results relative to the complete description of genotypic values as the sum of average effects, dominance deviations, AXA deviations, ..., etc., lead at once to the conclusion that, for the special case considered, all deviations of a specific kind in which the loci involved are specified are numerically equal and differ only in sign. Obviously Kempthorne's model may be greatly simplified here.

Three cases of interest are treated:

- Additive gene effects. The model for this situation may be expressed

$$a_{11,f_{11}} \dots a_{Kn_K,f_{Kn_K}} = m + A'T,$$

where  $T$  is the column vector of average effects for the plus alleles and  $A = 2 \text{ col } [(f_{11} - 1), \dots, (f_{Kn_K} - 1)]$ .

- Additive locus effects. The model for this case may be written

$$a_{11,f_{11}} \dots a_{Kn_K,f_{Kn_K}} = m + A'T + D'U,$$

where  $U$  is the column vector of dominance deviations defined for the two plus alleles and  $D = \text{col } [(-1)^{f_{11}}, \dots, (-1)^{f_{Kn_K}}]$ .

- Dual epistacy. The model for dual epistacy may be written

$$a_{11,f_{11}} \dots a_{Kn_K,f_{Kn_K}} = m + A'T + D'U + A'VA + A'WD + D'ZD,$$

where  $V$ ,  $W$ , and  $Z$  are the  $N \times N$  matrices of deviations of type AXA, AXD, and DXD, respectively, defined for all plus alleles, and

$$N = \sum_{i=1}^K n_i.$$

In each case artificial chromosome populations  $^*\Omega$  are formed in the following way: a random sample of  $2K$  chromosomes (two of each type) are "drawn" from  $\Omega$  and all  $3^K$  possible genotypes are formulated from these chromosomes. Regarding the chromosome population  $^*\Omega$  as a  $K$  "locus" random mating population with 2 "alleles" at each "locus", one may easily complete the decomposition of genetic variance at the chromosome level. Then, for each of the three cases (a)-(c) the average relationship are found between the chromosome components of genetic variance  $^*\sigma_A^2, ^*\sigma_D^2, \dots$  and the unknown components  $\sigma_A^2, \sigma_D^2, \dots$  of  $\Omega$  with respect to the conceptual space of  $2^{2N}$  distinct chromosome populations  $^*\Omega$ .

Logical experiments are designed to accomplish the objectives in the presence of environment. Estimation of the desired components of variance in cases (a) and (b) may be obtained with no complication except that replication (i.e., at least two independent populations  $^*\Omega$  formed from  $\Omega$ ) is required in the case of (b). In case (c) direct estimation is hampered by linkage effects but is still straightforward in at least two common situations.

Microfilm \$2.10; Xerox \$7.40. 160 pages.

<sup>†</sup>Kempthorne, O. 1954. The correlations between relatives in a random mating population. *Proc. Roy. Soc. (London)* Vol. 143, no. 910. pp. 103-113.

TOPICS IN DISCRETE CONVOLUTION TRANSFORMS

(L. C. Card No. Mic 59-691)

Edward Norman, Ph.D.  
Cornell University, 1958

The inversion and representation problems for the convolution transform

$$f(x) = \int_{-\infty}^{\infty} K(x-y)g(y)dy \quad (1)$$

where the kernel  $K(x)$  has Laplace transform of the form

$$e^{st}K(t)dt = e^{cs^2}e^{bs} \prod_1^{\infty} (1 - \frac{s}{a_j})^{-1} e^{-s/a_j} \quad (2)$$

possesses an extensive literature. If the functions  $f(x)$ ,  $g(x)$ , and  $K(x)$  are replaced by sequences  $f(n)$ ,  $g(n)$ , and  $k(n)$ , and integration is replaced by summation one arrives at the discrete version of (1),

$$f(n) = \sum_{-\infty}^{\infty} k(n-m)g(m). \quad (3)$$

The methods used to study the transform (1) with kernel



satisfying (2) may profitably be applied to the study of (3) if the kernel  $k(n)$  displays properties similar to those of  $K(x)$ .

H. Pollard and C. Standish (*Scripta Mathematica*, 1956) singled out the class of sequences  $k(n)$  which have a generating function of the form

$$\sum_{n=0}^{\infty} k(n)z^n = \prod_{j=1}^{\infty} (1-a_j)(1-b_j) / \prod_{j=1}^{\infty} (1-a_j z)(1-b_j z^{-1}) \quad (4)$$

as the class of sequences analogous to the functions  $K(x)$  satisfying (2) with  $c = 0$ . They prove the theorem: If (3) converges for one value of  $n$  it converges for all  $n$ , and  $\lim_{N \rightarrow \infty} [P_N(\delta)]f(n) = g(n)$ .  $P_N(\delta)$  is defined by the equations

$$\begin{aligned} \delta f(n) &= f(n-1) \\ [1/\delta]f(n) &= f(n+1) \\ P_N(\delta) &= \frac{\prod_{j=1}^N (1-a_j \delta)(1-b_j \delta^{-1})}{\prod_{j=1}^{\infty} (1-a_j)(1-b_j)} \end{aligned}$$

In the first section of this dissertation the author proves three representation theorems for the transform of Pollard and Standish. The theorems give necessary and sufficient conditions for a sequence  $f(n)$  to have the form (3) with  $g(m)$  bounded,  $g(m)$  non-negative, and  $g(m)$  in the class  $1_p$ ,  $1 < p < \infty$ . In each case the main condition on  $f(n)$  is that the sequences  $[P_N(\delta)]f(n)$  belong, uniformly in  $N$ , to the same class as  $g(m)$ . These theorems correspond very closely to their continuous counterparts.

Section two deals with the discrete analogue of the Weierstrass transform

$$f(x) = \frac{1}{\sqrt{4\pi}} \int_{-\infty}^{\infty} e^{-(x-y)^2/4} g(y) dy.$$

The natural analogue of the kernel  $e^{-x^2/4}$  of the Weierstrass transform is found to be the sequence  $\{I_n(1)\}_{n=0}^{\infty}$ , where  $I_n$  are the modified Bessel coefficients of the first kind. As before, the analogy is arrived at through the generating function of the sequence. The sequence  $\{I_n(1)\}$  is generated by the function  $e^{1/2(z+z^{-1})}$ , which corresponds to the Laplace transform  $e^{s^2}$  of the function  $e^{-y^2/4}$ .

Thus the discrete Weierstrass transform is defined as

$$f(n) = \sum_{m=-\infty}^{\infty} I_{n-m}(1)g(m) \quad (4)$$

whenever the sum converges for all values of  $n$ . The operator  $e^{-\frac{1}{2}(\delta+\delta^{-1})}$  is defined as

$$[e^{-\frac{1}{2}(\delta+\delta^{-1})}]f(n) = \lim_{t \rightarrow 0+} \sum_{n=-\infty}^{\infty} I_m(1)f(n-m)/\Gamma(1+t|m|), \quad (5)$$

and the following theorem is proved. If  $g(m)$  satisfies the condition  $g(m) = O(|m|^{-1}|x|^{-1|m|})$  as  $|m| \rightarrow \infty$ , then the transform (4) is inverted by (5).

Microfilm \$2.00; Xerox \$3.00. 33 pages.

# A METHOD FOR INVESTIGATION OF THE PROPERTIES OF SOLUTIONS OF THE EQUATION $\ddot{x} + f(x, t)\dot{x} + g(x, t) = \phi(t)$

(L. C. Card No. Mic 59-1291)

Eugene James Putzer, Ph.D.  
University of Minnesota, 1958

If  $\mathcal{F}$  is an operator and  $x$  is an element of some space then there are generally infinitely many ways of transforming the equation  $\mathcal{F}(x) = 0$  into an equivalent equation  $x = \Omega(x)$ . If  $\Omega(x)$  has certain properties, it is possible to draw conclusions about the solution of  $x = \Omega(x)$ , so we attempt to construct a function  $\Omega(x)$  which has the desired properties and such that the equation  $x = \Omega(x)$  is equivalent to  $\mathcal{F}(x) = 0$ .

Only ordinary differential equations are considered. After some introductory remarks showing how the method would be used on an  $n$ th order system of differential equations, it is developed in detail to fit the title equation. The range of  $t$  is  $[0, \infty)$  throughout.

The method can be used to establish existence, boundedness and asymptotic stability of solutions on  $[0, \infty)$ , and to obtain a sequence  $\{x_n(t)\}$  of successive approximations to the solution  $\xi(t)$  such that the convergence of  $x_n(t)$  to  $\xi(t)$  is uniform on the entire infinite  $t$ -axis  $[0, \infty)$ , i.e., by choosing  $n$  large enough the maximum error,  $\sup_{0 \leq t < \infty} |x_n(t) - \xi(t)|$ , can be made arbitrarily small. Explicit error estimates are given.

The boundedness theorems are of the type  $|\xi(t)| \leq B + Ce^{-\epsilon t}$  for all  $t$  where  $B$ ,  $C$  and  $\epsilon$  are explicitly obtained,  $B$  is independent of initial conditions, and  $C$  and  $\epsilon$  are functions of the initial values. The asymptotic stability results are of the type "If  $\xi^1(t)$  and  $\xi^2(t)$  are any two solutions starting in a certain region of the initial values space then for all  $t$ ,  $|\xi^1(t) - \xi^2(t)| \leq Ce^{-\epsilon t}$ ."  $C$  and  $\epsilon$  are explicitly obtained.

A section of examples is included, in which the method is applied to the van der Pol equation, to an equation of a nonlinear servomechanism, and to the  $n$ th order system

$$\ddot{\bar{x}} = A\bar{x} + \mu \bar{f}(\bar{x}, t, \bar{\alpha}) + \bar{\phi}(t, \bar{\beta}); \quad \bar{x}(0) = \bar{c}$$

in which  $\mu$ ,  $\bar{\alpha}$ , and  $\bar{\beta}$  are parameters. For this latter equation a theorem is developed which yields existence on  $[0, \infty)$ , boundedness, and asymptotic stability of the (unique) solution  $\bar{\xi}(t)$ , and continuity, uniform with respect to  $t$  in  $[0, \infty)$ , of  $\bar{\xi}(t)$  as a function of the parameters  $\mu$ ,  $\bar{\alpha}$ ,  $\bar{\beta}$ , i.e., if  $\bar{\xi}(t)$  and  $\bar{\xi}^*(t)$  are solutions corresponding to different values of  $(\mu, \bar{\alpha}, \bar{\beta})$  then if the difference in the two values of  $(\mu, \bar{\alpha}, \bar{\beta})$  is small, the difference between  $\bar{\xi}(t)$  and  $\bar{\xi}^*(t)$  will be small for all  $t$ . The bounds on  $\bar{\xi}(t)$ , the rate of convergence as  $t$  becomes infinite of the asymptotically stable solutions, and the error estimate for the successive approximations are all obtained explicitly.

Microfilm \$2.00; Xerox \$6.60. 137 pages.



# HAUSDORFF SUMMABILITY METHODS

(L. C. Card No. Mic 59-882)

Billy E. Rhoades, Ph.D.  
Lehigh University, 1958

The thesis is divided into seven chapters.

In speaking of a Hausdorff matrix  $H$ , generated by a sequence  $\mu$ , I shall usually denote the matrix by  $H_\mu$ , the method by  $H \sim \mu$ , and the convergence domain of  $H_\mu$  by  $(H, \mu)$ . However, when no confusion can result, I shall use  $H \sim \mu$  and  $(H, \mu)$  interchangeably.

I use  $A$  equivalent to  $c$  ( $A \equiv c$ ) to denote  $c_A = c$ , and  $A$  equivalent to  $I$  ( $A \equiv I$ ) to denote  $c_A = c$  and  $A$  regular.

The principal results of Chapter 1 are:

Let  $\mu_k = (ak+1)/(bk+1)$ , where  $a$  and  $b$  are distinct nonzero complex numbers such that  $a^{-1}$  and  $b^{-1}$  are not negative integers. Then  $H_\mu \equiv I \rightarrow \mathcal{R}(a) > 0$  and  $\mathcal{R}(b) > 0$ .

Let  $a, b$  be complex numbers,  $a \neq b$ ,  $\lambda_k = (ak+1)/(bk+1)$ ,  $\mu_k = \mu_k(\alpha) = \alpha + (1-\alpha)\lambda_k$ ,  $\alpha > 0$ . If  $\mathcal{R}(b) \geq \mathcal{R}(a) > 0$  or  $\mathcal{R}(b) > \mathcal{R}(a) \geq 0$ , then  $H_\mu \equiv I$ .

Let  $f(z)$  be analytic and not zero in  $C: |z - \frac{1}{2}| \leq \frac{1}{2}$ ,  $f(1) = 1$ . Then  $f(z) = \sum_{k=0}^{\infty} a_k (z - \frac{1}{2})^k$ , where the  $a_k$  are complex numbers and  $\sum_{k=0}^{\infty} a_k 2^{-k} = 1$ . Let  $\mu$  be any regular sequence, and let  $\lambda = 2\mu - 1$ . Then  $H_{f(\mu)} = \sum_{k=0}^{\infty} a_k 2^{-k} H_\lambda^k$ , and is equivalent to  $I$ .

Let  $f(z)$  be analytic in  $C: |z - \frac{1}{2}| \leq \frac{1}{2}$ ,  $f(1) = 1$ ,  $a > 0$ . Then  $H \sim \{f(a/(n+a))\} \equiv I \rightarrow f(z)$  has no zeros in  $C$ .

Let  $L(a, \alpha)$  denote the Hausdorff matrix method with  $\mu_k^\alpha = [a/(k+a)]^\alpha$ ,  $\mathcal{R}(a) > 0$ . Then  $L(a, \alpha) \equiv H^\alpha$  for all real  $\alpha$ .

Let  $R(a, b, \alpha)$  denote the matrix and the matrix method associated with  $\xi_k = d[(k+a)^\alpha + b]^{-1}$ , where  $d = a^\alpha + b$ ,  $[\mathcal{R}(a)]^\alpha > |b|$ . Then for each  $\alpha \geq 0$ ,  $R(a, b, \alpha)$  is regular and is equivalent to  $(C, \alpha)$ .

Mercer's Theorem is a special case of the second result with  $a = 0$ ,  $b = 1$ .

The fourth result listed is a generalization of the Hurwitz-Silverman Theorem.

Chapter 2 is divided into two sections, each of which deals with structural properties of Hausdorff matrices.

The first section considers the circumstances that result when one or more of the columns are restricted in some manner, including a characterization of the conservative Hausdorff matrices.

The second section considers properties of a Hausdorff matrix resulting from specified restrictions on the generating sequence.

Chapter 3 is devoted mainly to a discussion of properties of totally co-regular matrices. A co-regular matrix  $A$  will be called totally co-regular if, given any  $x \in s$  with  $x_n \rightarrow \infty$ , then  $A_n(x) \rightarrow \infty$ .

The first twelve theorems are generalizations of those of Hurwitz (Proc. London Math. Soc. (2) 26(1927)231-248) to totally co-regular matrices, and many of the proofs are modeled after those appearing in his paper.

The last several theorems deal with closure and convexity in  $C$  of the sets of co-regular, totally co-regular, and totally regular matrices, where  $C$  is the Banach algebra of conservative matrices.

Chapter 4 compares the total relative strength among the  $L(c, \alpha)$  methods, the  $R(c, b, \alpha)$  methods, the Hölder  $(H, \alpha)$  methods, and the Cesàro methods.

Let  $A$  and  $B$  be two conservative matrices,  $x \in s$ . Then  $B$  is said to be totally stronger than  $A$  ( $B$  t.s.  $A$ ) if  $c_A \subset c_B$  and  $A_n(x) \rightarrow \ell$  implies  $B_n(x) \rightarrow \ell$ ,  $|\ell| = \infty$ .

Chapter 5 contains theorems which deal with products of totally regular Hausdorff matrices, and compares the hypergeometric method  $(H, \alpha, \beta, \gamma+1)$  (see Basu, Proc. Amer. Math. Soc. 5(1954)226-238) totally with the  $L(c, \gamma)$  methods.

Chapter 6 deals with the total relative strength of three Hausdorff methods that are equivalent to, or stronger than, the  $(C, 1)$  method. The three methods are discussed non-totally in Greenberg and Wall, Bull. Amer. Math. Soc. 48(1942)774-783.

Chapter 7 compares the total relative strength of the Nörlund methods, the  $(\bar{N}, p_n)$  method discussed by Hardy, Divergent Series, Oxford, 1949, page 57, and the  $L(c, \alpha)$  method. Microfilm \$2.70; Xerox \$9.40. 208 pages.

## BOUNDARY VALUE DISTRIBUTIONS

(L. C. Card No. Mic 59-589)

Ralph Newell Townsend, Ph.D.  
University of Illinois, 1958

Analogous to the approach used by Sebastiao e Silva<sup>1</sup> in constructing the Schwartz distributions, this paper considers the extension of a class of functions algebraically to allow inverses of all orders to the indefinite integral, resulting in the set of "boundary-value distributions."

A set  $M^*$  is said to be an "extension of  $M$  under  $T$ " if  $T$  is defined on  $M^*$ , maps  $M^*$  into itself and  $M^*$  contains a subset  $M'$  corresponding 1 - 1 to  $M$  such that  $T(x') = T(x)$  when  $x' \in M' \rightarrow x \in M$ .

The general theorems are then the following: Let  $T$  be a 1 - 1 transformation of a set  $M$  into itself. Then we can construct an extension  $M^*$  of  $M$  under  $T$  such that  $T$  possesses inverses of all orders on  $M^*$ , and  $M^*$  is minimal in this respect. Furthermore, if  $U$  is another such operator on  $M$  and  $T$  and  $U$  commute then  $M$  may be extended under both  $T$  and  $U$  to  $M^{**}$  to allow all inverses, and this result generalizes to  $n$  such permutable operators.

$M^*$  may be expressed as the set of all ordered pairs  $(T^n, x)$ ,  $x \in M$  and  $n = 0, \pm 1, \pm 2, \dots$  modulo an equivalence relation  $\sim$  defined by:  $(T^n, x) \sim (T^m, y)$  if  $y = T^p x$  and  $p = n - m > 0$  or  $x = T^p y$  and  $p = m - n > 0$ . The elements of  $M^{**}$  may be written  $(T^n, U^m, x)$  with  $x \in M$  and  $n, m = 0, \pm 1, \pm 2, \dots$  with a similar equivalence relation.

The set of boundary value distributions on  $E_1$  is constructed letting  $T$  be the Lebesgue integral  $\int_a^x f(x)dx$  on an interval  $[c \leq a \leq d]$  and  $M$  the set of integrable functions on  $[c, d]$  modulo almost everywhere equality. These b-v distributions may have "point values" at certain points if  $f$  in  $(T^n, f)$  is such that  $f^{(n)}$  exists and is  $n$  times integrable at those points.

Arithmetic properties consistent with those of point functions are defined, and the derivative of a b-v distribution is defined and compared with the operator  $T^{-1}$  and with derivation of point functions. A product  $(T^n, f) \cdot (T^{-n}, g)$ ,  $n \geq 0$ , is defined if  $f \cdot g$  is integrable, and is extended to  $(T^0, f) \cdot (T^{-n}, g)$  when  $f$  satisfies certain conditions of differentiability. The limit of a sequence of b-v distributions is also defined and its properties are considered.



If  $T$  is the Lebesgue integral  $\int_a^x f(x,y)dx$  and  $Uf = \int_b^y f(x,y)dy$  and  $M$  is the set of integrable functions on an interval  $c \leq x \leq d$ ,  $e \leq y \leq h$  containing  $(a,b)$  then the general theorem yields the  $b$ - $v$  distributions on  $E_2$ . These have properties similar to those on  $E_1$ . Two products are defined:  $(T^p, U^r, f) \cdot (T^{-p}, U^{-r}, g)$  and  $(T^{-p}, U^r, f) \cdot (T^p, U^{-r}, g)$  where  $p, r \geq 0$  and  $f \cdot g$  is integrable. Both products

are generalized to weaker conditions on the exponents if the functions have certain other properties.

Finally, several examples to the theorems are given in matters relating to the  $\delta$  "function".

Microfilm \$2.00; Xerox \$3.80. 69 pages.

1. Sebastiao e Silva, J., *Sur Une Construction Axiomatique de la Theorie des Distributions*, Revista Fac. Ciencias Lisbon, Series 2A, Part A, Vol. 4, (1955) P. 79-186.

## MINERALOGY

### THE INFLUENCE OF THE LAMINAR FLOW BOUNDARY LAYER ON CRYSTALS GROWING FROM SOLUTION

(L. C. Card No. Mic 58-7944)

Allan Eugene Carlson, Ph.D.  
University of Utah, 1958

Chairman: L. B. Sand

A survey of the available literature on transformation mechanisms discloses that relatively little fundamental work has been done on crystal growth from solution as a rate process.

The principal difficulty encountered in the published studies appears to be the lack of a means of clearly separating the diffusion step of the process from the succeeding transformation of particles from the solution phase to the crystal phase. Some success has been achieved in describing the diffusion process for growth of a crystal in a completely stagnant solution; most crystals, however, grow from solutions subjected to some degree of agitation or flow. Present theories do not appear to relate satisfactorily the fluid dynamic and diffusion parameters to the growth process occurring at the crystal surface. Furthermore, they do not appear to present a suitable method of determining the degree of supersaturation at the growing surface; thus, for lack of knowledge of the most important variable, one cannot investigate the detailed kinetics of the surface transformation. This investigation was initiated, therefore, in an attempt to eliminate this difficulty. The specific approach chosen consisted of theoretical and experimental studies of the relationship of crystal growth to the laminar flow boundary layer formed on the crystal surface by a flowing solution.

Theoretical expressions were developed for the mass transfer of a solute to a surface represented by a flat plate lying parallel to the direction of fluid flow. These expressions were based on the heat transfer analogy and were developed for three ideal models of plate configuration and distribution of concentration along the surface.

Each of the models was then compared theoretically with the crystal growth process and with experimental measurements of growth rates of  $KH_2PO_4$  ("KDP") and  $NH_4H_2PO_4$  ("ADP") bipyramid crystal faces. One model, that of a semi-infinite plate with the surface concentration decreasing downstream from the leading edge in a specified way, was found to be consistent with the process of

crystal growth from solution. This was formulated as a fluid dynamic theory of crystal growth.

When fluid dynamic parameters and solution properties were quantitatively related to crystal geometry and rates of crystal growth, it was found that the local supersaturation could be theoretically specified for every point on the surface. For certain ranges of parameters, a deficiency or "starvation" of growth was predicted to occur beyond a certain distance from the edge of a crystal face. In large ADP crystals, one type of commonly observed "veil" consists of a zone of solution-filled inclusions. Observed examples of these veils were found to have formed under conditions in reasonable agreement with those required by the theory for the phenomenon of "starvation" growth.

The growth rates of small KDP and ADP crystals were measured in the laboratory and comparative growth rates were measured for large ADP crystals produced in commercial growing equipment. In all cases it was found that the crystals could grow at a "normal" rate, or at some higher, "abnormal" rate up to three times as great in magnitude. The theory indicates that under certain conditions, the "abnormal" rates could cause the occurrence of "starvation" growth.

Previously published theories of crystal growth from solution are based on the postulation of the existence of a relatively thick layer of stagnant solution on the surface through which the solute must diffuse. Experimental investigations have failed to verify the existence of this layer; the results indicate that if it does exist, its thickness is many orders of magnitude less than required by these theories. The fluid dynamic theory of crystal growth herein developed does not require the assumption of a stagnant layer; at the same time, it does not rule out the existence of a negligibly thin layer of the proportions accepted for surface chemical processes. This concept was applied to the screw dislocation theory of Burton, Cabrera, and Frank. The resulting modification yielded relationships in consistent agreement with the experimental measurements of the growth rates of KDP and ADP bipyramid faces.

This modified screw dislocation theory was combined with the fluid dynamic growth theory to calculate the macroscopic surface contours of crystal faces growing under various environmental conditions. It is shown that for normal growth of KDP, the predicted deviation from ideal orientation of the bipyramid faces is of the same order of magnitude as that commonly observed by crystallographers on crystals of substances grown from solution, as deviations from the "Law of Constancy of Interfacial Angles."



The application of the screw dislocation theory of crystal growth by Burton, Cabrera, and Frank suggests that the "abnormal" growth rates in KDP and ADP are caused by critical concentrations of screw dislocations induced by localized disturbance of the crystal lattice. Critical concentrations of screw dislocations were predicted to occur at the boundary planes between misoriented blocks of crystal lattice formed either by fractures or by imbedded crystallites. It was predicted that the surface slope of a hill-ock formed by such augmented growth would be related only to the degree of misorientation at the boundary, and be independent of bonding energies, temperature, or supersaturation. Preliminary measurements were made on hill-ocks formed on the prism faces of large ADP crystals by

growth around misoriented crystallites imbedded in the host lattice. The results agreed with theory within experimental error.

The results of this investigation are probably applicable to all crystals grown from a stirred solution, be they synthetic or of natural origin. Mineral crystals of particular interest would be those formed in hydrothermal vein deposits and in certain types of igneous rocks. The mass transfer expressions were developed in general form, and should be applicable to any diffusional process involving large bodies in a flowing medium, provided one of the ideal models used is consistent with the geometric requirements of the process.

Microfilm \$2.25; Xerox \$8.00. 172 pages.

## MUSIC

### THE SOUTHERN BAPTIST SUNDAY SCHOOL BOARD'S PROGRAM OF CHURCH MUSIC

(Publication No. 24,482)

Floyd H. Patterson, Jr., Ph.D.  
George Peabody College for Teachers, 1957

A 2nd listing. Please see abstract on page 2583.  
Microfilm \$4.70; Xerox \$15.80. 366 pages. Mic 58-5230.

## PHARMACOLOGY

### THE INFLUENCE OF CERTAIN STEROIDS ON THE DISTRIBUTION OF SODIUM AND POTASSIUM AND ON THE CONTRACTILITY OF HEART MUSCLE

(L. C. Card No. Mic 59-842)

Ralph D. Tanz, Ph.D.  
University of Colorado, 1958

Supervisor: Professor Richard W. Whitehead

The cardiac glycosides represent a chemical complex comprising one or more sugar molecules attached through the C-3 position of a steroid nucleus, and an unsaturated lactone attached to the C-17 position. In an attempt to correlate chemical structure with cardiac activity most of the previous workers have investigated the significance of either the sugar or lactone portions of the cardiac glycosides.

Employing the cat papillary muscle preparation, with certain modifications developed in the course of this work, certain steroids were tested for their direct cardiotonic activity. Under rigidly defined experimental conditions a steroidal substance was stated to possess cardiotonic activity if it produced a positive inotropic action in a 'therapeutic' concentration of about 1 microgram per ml of perfusate. Conversely, it was stated to be 'toxic' whenever a negative inotropic action resulted using a concentration above 10 micrograms per ml of perfusate. In addition,

those steroids (in proper concentrations), producing a positive inotropic effect, were noted to cause an increased intramuscular uptake of  $\text{Na}^{22}$  and a loss of  $\text{K}^{42}$ , whereas a reversal in this cationic distribution occurred when a negative inotropic action resulted.

A histological correlation of the muscles treated with 'therapeutic' concentrations was obtained in comparison to fresh papillary tissue. Similarly, a histological correlation was obtained between those muscles treated with 'toxic' concentrations, and the untreated controls. Employing the whole isolated heart preparation, it was shown that the addition of certain steroids to the perfusate in low concentrations, would overcome cardiac failure. Conversely, failure could be produced by the addition of these steroids in 'toxic' doses.

Using one or more of these preparations, it was found that 9- $\alpha$  fluorohydrocortisone, cortisone, and in all probability, norethandrolone (Nilevar), hydrocortisone and desoxycorticosterone possessed direct cardiotonic activity on isolated cardiac tissue. Extensive experiments with hydroxydione (Viadril), yielded questionable results. Estrone, over a wide range of concentrations, was apparently without cardiotonic activity as defined herein.

A structural comparison of the cardiotonically active compounds employed, both in this work and by others, was made. The results of this comparison showed that there are certain structural similarities common to all cardiotonically active steroids tested. These are: a ketonic



group at C-3, a methyl group at C-18 and C-19, and a two-carbon side chain at C-17.

It is hoped that this information will provide more rationale to the development of newer cardiac drugs.

Microfilm \$2.30; Xerox \$8.00. 175 pages.

#### THE RELATION BETWEEN PYRIDOXINE ANALOGUES AND HYDRAZIDE INDUCED CONVULSIONS

(L. C. Card No. Mic 58-5188)

Ronald Gay Wiegand, Ph.D.  
Emory University, 1956

The convulsant hydrazides semicarbazide, thiosemicarbazide, thiocarbohydrazide, and isonicotinyl hydrazide produce xanthurenic acid excretion in dogs 30 to 45 minutes after intravenous administration of convulsant doses, but desoxypyridoxine under similar conditions does not. Thiocarbohydrazide was also demonstrated to cause a decrease in the free gamma-aminobutyric acid level of mouse brain, significant at the ten per cent probability level. The enzymatic reactions related to both of these effects, involving kynureninase and glutamic decarboxylase, respectively, require pyridoxal phosphate as coenzyme. The effect is that expected if the activity of the enzyme is decreased. Glutamic-oxalacetic transaminase activity in mouse brain is not changed by *in vitro* addition of pyridoxal phosphate or pyridoxal phosphate semicarbazone or by *in vivo* administration of semicarbazide. The inhibition of this system *in vitro* by semicarbazide may be due to combination of semicarbazide with alphaketoglutaric acid, and therefore an apparent decrease in activity due to substrate depletion.

The acid dissociation constants of carbohydrazide, semicarbazide, thiocarbohydrazide, thiosemicarbazide, and aminoguanidine, determined at 25°C, are 4.29, 3.70, 3.26, 2.08, and 1.77, respectively. There is no strict correlation of acid dissociation constant and convulsant potency of the hydrazides. The *in vitro* reaction between pyridoxal phosphate and carbohydrazide, semicarbazide, thiocarbohydrazide, thiosemicarbazide, and isonicotinyl hydrazide at pH 7.4 was demonstrated, decreasing in rate in the order listed. Pyridoxal also reacts with semicarbazide and thiosemicarbazide, but at a much lower rate. A

linear relation between the acid dissociation constants and the specific reaction rates for the formation of pyridoxal phosphate carbohydrazone, pyridoxal phosphate semicarbazone, pyridoxal phosphate thiocarbohydrazide, and pyridoxal phosphate thiosemicarbazone, both at 25°C, was obtained. This indicates that the reactive species of the hydrazide molecule is the cation. By determining the specific reaction rates at four to six temperatures between 12 and 37°C for each hydrazide, the experimental activation energies were obtained. For the reaction between pyridoxal phosphate and carbohydrazide, semicarbazide, thiocarbohydrazide, thiosemicarbazide, and isonicotinyl hydrazide the values are 9.38, 6.40, 9.56, 9.36, and 9.87 kcal./mole, respectively.

The vitamin B<sub>6</sub> content of mouse brain is about 3.3 ugm. per gm. wet weight. Since 97 per cent of the B<sub>6</sub> activity of a perchloric acid mouse brain extract is not adsorbed on a Dowex-50-Na ion exchange resin column, the major portion, if not all, appears to be present in the phosphorylated form. By separation on a 20 x 0.9 cm. Dowex-1-Cl column, eluting with 0.005M citrate buffer at pH 4.5, perchloric acid extracts of mouse brain were found to contain two main fractions; 45 to 58 mugm. pyridoxamine phosphate per 100 mgm. wet weight of tissue and 94 to 112 mugm. pyridoxal phosphate per 100 mgm. wet weight of tissue. The B<sub>6</sub> was assayed microbiologically with *Saccharomyces carlsbergensis* as a test organism. About one hour after I. P. administration of hydrazides, mouse brain extracts had normal pyridoxamine phosphate levels, decreased pyridoxal phosphate levels, and a third component identified as the pyridoxal phosphate hydrazone. Hydrazides demonstrated to form this complex *in vivo* were carbohydrazide, semicarbazide, thiocarbohydrazide, thiosemicarbazide, and isonicotinyl hydrazide. Mouse brain, liver, and kidney homogenates, at pH 5.0 and 7.4, possess phosphatase activity for the substrates pyridoxamine phosphate, pyridoxal phosphate, and pyridoxal phosphate semicarbazone.

It is concluded that one possible mechanism of action of the hydrazides in producing central nervous system symptoms is the formation of pyridoxal phosphate hydrazones. This complex formation makes the pyridoxal phosphate unavailable to critical apoenzymes. The resulting enzymatic deficiency is postulated to be the cause of hydrazide induced seizures.

Microfilm \$2.00; Xerox \$4.80. 94 pages.

#### PHILOSOPHY

##### THE PROBLEM OF SELF-KNOWLEDGE

(L. C. Card No. Mic 59-199)

William Haines Bossart, Ph.D.  
Northwestern University, 1958

Supervisor: William A. Earle

The purpose of this thesis is to formulate a theory of the self by developing and synthesizing certain basic insights which are central to existential thought as it is

represented by Gabriel Marcel, Martin Heidegger and Jean-Paul Sartre. The basic contention which is defended here is that man is a being whose nature is radically other than the nature of the other beings encountered in the world and that it is this distinction which defines the fundamental nature of the human self.

The discussion begins with a phenomenological analysis of consciousness which reveals that consciousness is basically intentional, that it is always conscious of an object from which it can be distinguished. Furthermore, consciousness is revealed as existentially dependent upon



its object for without an object consciousness would be conscious of nothing or unconscious. Thus consciousness is related to something other than itself which is its object. But an examination of human experience shows that the division of experience into objects and those acts of consciousness which apprehend these objects is not primary. In explicit or objective experience the individual has already accomplished something; he has broken with his immediate participation in experience by stepping back from experience and objectifying it. The transformation of implicit experience into explicit experience can be accomplished only if man is free to take this backward step. Hence the study of consciousness leads us to inquire into the nature and possibility of human freedom.

Man's freedom is revealed each moment in his daily activity. In the first place we find that a human being can never be characterized by any set of predicates or attributes in the manner in which we can characterize the nature of a chair or a stone. Each time that I try to affirm something about myself I feel myself slipping away within that act of affirmation. Thus man is revealed as a being who is always more than anything which can be said about him. He is a being whose being is always in question. Man transcends the objectifiable aspect of his being. He is never simply what he is but is revealed as a potentiality to be. Thus the individual finds himself in a world faced with various possibilities among which he must decide. Man, then, is according to how he chooses to exist. Yet the various ways in which the individual can exist, the various possibilities which are open to him, are not properties which he possesses but possible ways of existing concretely. Yet if the individual is free to choose how he will exist, he is also free to choose for or against himself. He is free to acknowledge his freedom or to hide from his true nature, to mask his freedom from himself. Thus the problem of self-knowledge is no longer one of locating the self and then describing its true nature. Rather we must investigate the various ways in which the self makes its presence in the world manifest. In short, we must turn our attention to authentic and inauthentic self-existence.

The nature of inauthentic self-existence becomes clear when we examine the individual as he appears in daily life. In daily life the individual finds himself entangled in a world which constantly makes demands upon him, which forces him to play the role that it has assigned to him. Thus the individual either remains simply one being among many or he revolts against the structure thrust upon him by the world and tries to constitute himself as an individual ego. But the ego continually tries to identify itself with certain areas of its situation. It tries to become something instead of being someone, an undertaking which inevitably leads to despair. Only if the individual constitutes himself as a person can he exist authentically. To exist as a person he must appear to another person as unique and responsible, as the ultimate agent of all his acts and the creator of his destiny.

Microfilm \$2.50; Xerox \$8.60. 189 pages.

## THE CONCEPT OF POSSIBILITY IN C. I. LEWIS' EPISTEMOLOGY

(L. C. Card No. Mic 59-1002)

Louisa Shannon Du Bose, Ph.D.  
Bryn Mawr College, 1958

In this dissertation, I shall examine the concept of possibility in C. I. Lewis' epistemology. I shall attempt to show that the concept under consideration is essential to Lewis' critique. Finally, I shall show that this apprehension of possibility constitutes an important contribution to the general theory of knowledge.

The definition of possibility requires, first, that the position of this concept in Lewis' whole epistemology be indicated. Secondly, one must distinguish the ways in which it is used. Lewis discovers two elements to knowledge. These are qualia, or immediacies of sense and the a priori, based on the categories contributed by the mind. In the human mind, the grounds of knowledge are, then, the mind's receptivity and its rationality. Lewis will not grant, however, that a mind which is merely rational and receptive knows the world. Knowledge could emerge only in an active creature. Action in turn is rooted in valuation. The conception of possibility is formed to account for the active nature of the knower. It demonstrated the close connection which Lewis finds between knowledge and valuation.

There are two somewhat different senses in which the human being is active. The first is physical activity. It is the root of knowledge and of valuation in general, and it is necessary to the process of empirical cognition. Man is also active in the sense that the mind prescribes categories to experience. These are chosen from among various possible systems.

In Lewis' theory, possibility is a condition of knowledge. It is the requirement that initiative is necessary for cognition. Several usages of possibility are to be distinguished. With reference to valuation, possibility means the preconception of possible future values towards which one might aim. Epistemologically, there are several related meanings. First, the possible is the verifiable. There is, as well, another and related sense of possibility which applies to choices among imagined ways of identifying immediate experience. In the world external to the knower, or at least in the world of his sensa, still another kind of possibility occurs. If any quality were pervasive, one could not suppose it otherwise, or imagine the world without it. Hence, it could not be objectified, and it could never be known. Empirical cognition requires this "off-and-onness" in order to bring about the objectification of qualia.

A similar condition holds of the a priori. Lewis emphasizes the importance of alternative categorial systems and alternative logics. Systematization of any sort (whether categorial organization or formulation of logics) requires that there be alternative concepts. In order to submit qualia to a system of categories, there must be a choice of concepts under which to subsume the given. In order to discover a system itself, there must be other possible systems. Lewis argues that we could not discover an absolutely universal and necessary categorial system. Any system of categories and any system of formal logic can be known a priori because it is a choice among possible systems.



The conception of the possible as the supposition of alternatives is not entirely new. The view that we grasp things intellectually in the light of distinguishable differences has been suggested before. The application of this approach, based on the recognition of alternative systems of categories, to the understanding of the *a priori* functions of the mind is, however, a departure from the tradition of Kantian epistemology. It is my contention that the analysis of Lewis' conception of possibility will furnish the key to an understanding of differences between his philosophy and that of Kant. Moreover, I believe that it is the key to Lewis' entire epistemology.

Microfilm \$2.55; Xerox \$8.80. 193 pages.

#### HUME'S THEORY OF MORAL JUDGMENT

(L. C. Card No. Mic 59-501)

Marvin Leon Easterling, Ph.D.  
University of Illinois, 1958

The problem of understanding Hume's theory of moral judgment is complicated by three factors: the interpretations of some of his critics, certain ambiguities in Hume's terminology, and some apparently fundamental divergencies internal to his ethical writings. The latter can be described as the trends toward subjectivism and noncognitivism on the one hand, as contrasted with objectivism and cognitivism on the other. These trends give rise to conflicts to some extent genuine, and to some extent largely verbal. In either case, they are closely related to the ambiguities which have misled many critics, and sometimes perhaps even Hume himself. The consequence has been distorted interpretation stressing either one or the other of the tendencies mentioned, or if fully recognizing both, then terminating with charges of inconsistency and self-contradiction.

Many major criticisms can be obviated by the tedious but simple method of making detailed textual comparisons, especially between well known and many not so well known passages exemplifying first subjectivism and then objectivism. But such comparison, while avoiding oversimplification, produces a bewildering awareness of the complexity of Hume's views, a complexity demonstrated by showing how widely distributed throughout his ethical writings is the textual evidence of these two broad trends. While his subjectivism is widely acknowledged, it is well

to see clearly how fundamental it is before turning to the less well known objectivistic themes. But having shown this, I have then tried to correct traditional accounts of his ethics by showing Hume's stress on the universality of benevolence, which produces moral judgments according to a "general unalterable standard." Although some scholars recognize this aspect of Hume's ethical views, they go too far in making his account of moral judgment more objectivistic than he does. Sometimes an attempt to justify this interpretation is made by reference to a change in Hume's position from *Treatise* to the *Enquiries*. But again careful textual comparisons make this alleged development implausible.

If it cannot be shown that Hume rejects one position in favor of another, however, the problem of reconciling two apparently contradictory views remains. I have attempted to solve this problem by an hypothesis concerning the distinction Hume makes between the "vulgar" (i. e., the common) and the "true" and "false" philosophical views. This distinction, made first in his account of belief in external objects, is based on recognition that there is no adequate theoretical or philosophical evidence for such belief, but that its justification is practical, and in practice is accepted by layman and philosopher alike. The "false" philosophy, by its mistaken insistence on completely rational evidence for all belief, would instead terminate in an utter subjectivism, the impracticability of which leads to its transcendence by the "true" philosopher, whose action and language thus becomes more like that of the vulgar-objectivism.

My general conclusion is that Hume actually applies this same distinction in his theory of moral judgment, though without explicit acknowledgement. If moral judgment required a thoroughly rational basis, it would be subverted altogether and an utter relativism would result from this "false" philosophical view in ethics. The "true" ethical philosophy, however, fully recognizes the cogency of subjectivistic analyses of morals, while acknowledging the practical necessity of quasi-objectivistic moral judgment and values. This view is thus again closer to subjectivism in theory, closer to vulgar objectivism in action, but more "truly" philosophical than either by recognizing the practical limits of reason even while exercising reason to its fullest capacity within those limits. The vulgar/philosophical distinction thus explains the presence in Hume's ethics of apparently conflicting interpretations of moral judgment, and Hume's apparent unconcern for the conflict fosters this appearance deliberately.

Microfilm \$4.65; Xerox \$15.60. 363 pages.



## PHYSICS

### PHYSICS, GENERAL

#### OXIDATION OF MAGNESIUM SINGLE CRYSTALS AND EVAPORATED FILMS

(L. C. Card No. Mic 59-970)

Richard Robert Addiss, Jr., Ph.D.  
Cornell University, 1958

The oxidation of magnesium single crystals at high temperatures, and evaporated magnesium films at room temperature, was studied by means of a sensitive (minimum detectable weight change of the order of  $10^{-8}$  gm) microbalance, which is constructed entirely of quartz and is capable of being baked-out to obtain ultra-high vacuums. The single crystals were prepared with either the (100) or (001) crystallographic plane parallel to the surface, and were oxidized at 400 and 440°C at an oxygen pressure of 2.5 mm Hg. Emphasis was placed on working with clean, smooth, distortion-free surfaces on the single crystals and with very pure materials (both metal and oxygen). The oxidation was allowed to proceed for periods of 5000 to 8000 minutes. Since it was not possible to remove the oxide film always present on magnesium which has been exposed, all experiments with single crystals began with an initial thin oxide film already present.

The evaporated films were prepared in ultra-high vacuum and thus the formation of the first few oxide layers could be studied.

The results of the experiments with single crystals show that initially the basal plane oxidizes at a greater rate than the prismatic plane, but that in the later stages of the oxidation, the rate on the basal plane is slower than that on the prismatic plane, so that after a long enough time the total oxide thickness is less on the basal plane than on the prismatic plane. There is a "break" in all the oxidation curves at a thickness of about 100 Å (in addition to the initial oxide film), after which the oxidation rate increases. Essentially no temperature dependence of the oxidation is observed. The kinetics of the oxidation for the region before this break are compared with the theory of Landsberg.<sup>1</sup> Speculations are made concerning the mechanism for the oxidation after the break, where a cubic law is obeyed for the basal plane, and an almost linear law followed by a parabolic law is obeyed for the prismatic plane.

The evaporated films were oxidized initially at oxygen pressures of  $10^{-6}$  -  $10^{-7}$  mm Hg. An induction period is observed followed by a very rapid increase in the oxide thickness, after which the oxidation rate is suddenly reduced almost to zero, indicating that a limiting oxide thickness is reached at a few monolayers. A further increase of the oxygen pressure to 2.5 mm Hg approximately doubled the apparent limiting thickness. The kinetics of the process are discussed, and a comparison is made with the Landsberg theory.

Microfilm \$2.00; Xerox \$4.80. 95 pages.

1. P. T. Landsberg, J. Chem. Phys. 23, 1079 (1955).

#### ANNIHILATION OF POSITRONS IN AN ELECTRON GAS WITH APPLICATION TO METALS

(L. C. Card No. Mic 59-23)

Mirza Abdul Baqi Bég, Ph.D.  
University of Pittsburgh, 1958

The annihilation of positrons in a free electron gas is examined. It is found that prior to annihilation, radiationless capture of the positron by an electron, to form positronium, is very likely, the capture rates being several orders of magnitude higher than the annihilation rates. The positron could then decay either by annihilating with its bound electron, or by pick-off with a free electron. We find that the latter process is severely restricted by the exclusion principle, in such a way however that the annihilation rate becomes almost independent of the electron density, for the range of densities realized in metals. The positron mean life taking account of both channels of decay turns out to be  $4.8 \times 10^{-10}$  secs.

To the extent that metals can be represented by a free electron gas, the uniformity of lifetimes is in good agreement with experimental observation. However the magnitude of the lifetime is not in satisfactory agreement, the most recent experimental determination giving  $(2.5 \pm 0.3) \times 10^{-10}$  secs. Causes for this discrepancy are listed and it is pointed out that in the region of alkali metals, the disagreement between the present theory and experiment is less than that in a previous calculation. In this connection, it is also shown that the hypothesis of positronium ion formation, invoked by Ferrell for the low density case of Cesium, does not account for the observed lifetime. The ionic lifetime is found to be too large, by a factor of 10 for Cs, and increases quite sharply with the Fermi energy (electron density). Microfilm \$2.00; Xerox \$3.00. 46 pages.

#### MEASUREMENT OF WALL HEAT TRANSFER AND OF TRANSITIONS TO TURBULENCE DURING HOT GAS AND RAREFACTION FLOWS IN A SHOCK TUBE

(L. C. Card No. Mic 59-878)

Albert John Chabai, Ph.D.  
Lehigh University, 1958

Existing theories of fluid flow in shock tubes predict certain values for the pressure, density, velocity and temperature of the gas as functions of position and time. Experimental investigations have shown that the conditions predicted by theory are not fully realized in actual shock tube flows. These deviations from theory are attributed largely to dissipative effects occurring at the shock tube walls, but evidence for this has in the past been largely circumstantial. Important information on the dissipative phenomena themselves can be obtained from measurements of wall temperature and fluid-to-gas heat flux as functions of time.



A thin film resistance thermometer has been developed for the study of transient boundary layer flows in the shock tube. The response time is less than 1  $\mu$ sec. With this instrument wall temperatures are measured, gas-to-wall heat transfer rates may be determined, and transitions to turbulent flow detected. Measurements of wall heat flux during laminar flow are presented and compared with theories for the hot gas, the cold gas, and the rarefaction regions of shock tube flows. The experimental results indicate an excellent agreement with the theories of hot gas flow, a general consistency with the theory of cold gas flow, but some unaccountable deviations from the theoretical expectations for rarefaction flows. Measurements of the time at which transition from laminar to turbulent flow occurs are also presented for a number of hot gas and rarefaction flows. A Reynolds number for the hot gas flow is proposed whose critical value predicts the time at which the laminar flow is observed to become turbulent. Several Reynolds numbers for the rarefaction flow are proposed, but no correlation between these Reynolds numbers and the measured transition times is found to exist. The instrument described allows previously unexplored boundary layer phenomena to be investigated.

Microfilm \$2.00; Xerox \$4.80. 95 pages.

#### OXIDATION OF EVAPORATED MAGNESIUM FILMS

(L. C. Card No. Mic 59-677)

Mitchell Simmons Cohen, Ph.D.  
Cornell University, 1958

The objective of this investigation was the study of the oxidation kinetics of a freshly prepared metal surface in the early stages of the reaction. For this purpose the kinetics of the low-temperature and low-pressure oxidation of evaporated magnesium films were studied by the Wagener flow method.<sup>1</sup>

The results are expressed in terms of the striking probability, which is defined as the ratio of the number of molecules of oxygen taken up by the magnesium per second to the number striking the magnesium per second. In the initial high sticking-probability period of an oxidation experiment, which usually continues until three or four monolayers of oxide are formed, an increase of sticking probability with time was often observed; this is consistent with a nucleation effect. The sticking probability and its dependence on time for both the initial period and the later period were, however, very sensitive to the preparation of the magnesium surface.

During the later period of rapidly-falling sticking-probability, the dependence of sticking probability on temperature and pressure was studied and found to be very small. The sticking probability monotonically decreased in this later period; a limiting oxide thickness of about 27 Å was obtained in the temperature range from -75°C to 140°C.

A good fit to the data in the entire range of the rapidly-falling sticking-probability region was achieved using the inverse logarithmic law. To fit the direct logarithmic law to the data two different parameters were required. The only theories that satisfy the experimentally observed pressure and temperature dependence and whose param-

eters are in reasonable agreement with the data are the Landsberg theory<sup>2</sup> and a modified Mott theory.<sup>3</sup> It can be concluded that these two theories are consistent with the experimental results, although there may also be other interpretations that would yield rate laws consistent with the data. Microfilm \$2.10; Xerox \$7.40. 159 pages.

1. S. Wagener, Proc. Inst. Elec. Engrs. 99 Pt III, 135 (1952)
2. P. T. Landsberg, J. Chem. Phys. 23, 1079 (1955)
3. N. Cabrera and N. F. Mott, Repts. on Progress in Physics 12, 163 (1948-1949)

#### INFRARED LATTICE ABSORPTION IN CRYSTALS OF DIAMOND STRUCTURE

(L. C. Card No. Mic 58-7220)

Joan Feynman Hirshberg, Ph.D.  
Syracuse University, 1958

The infrared absorption spectrum of homopolar crystals is investigated. It is shown that the symmetries of the diamond structure will allow a second order electric dipole moment to exist. The photon will be absorbed with the creation of two phonons. The resulting absorption will consist of summation bands. The experimental infrared absorption in diamond, silicon, and germanium is compared with the theory using experimental values for the frequencies of vibration of the lattice. The theory and experiments are in excellent agreement for germanium. There is very little information on the vibration frequencies of diamond, but theory and experiment are consistent. For silicon, the summation bands do not lie in the proper region to explain the absorption that was previously believed to be due to the effect discussed here.

Microfilm \$2.00; Xerox \$4.80. 91 pages.

#### IONIC CONDUCTIVITY AND DIFFUSION IN CESIUM BROMIDE AND CESIUM IODIDE

(L. C. Card No. Mic 59-539)

David William Lynch, Ph.D.  
University of Illinois, 1958

Ionic transport properties of CsBr and CsI were investigated by means of electrical conductivity measurements and tracer diffusion coefficient measurements on single crystals. The measured diffusion coefficients can be expressed as:

$\text{Cs}^{134}$ in CsBr	$D = 15.1 \exp(-1.54\text{ev/kT})$ between 320°C and 550°C
$\text{Br}^{82}$ in CsBr	$D = 3.92 \exp(-1.42\text{ev/kT})$ between 415°C and 530°C and $D = 0.441 \exp(-1.29\text{ev/kT})$ between 330°C and 415°C
$\text{Cs}^{134}$ in CsI	$D = 14.24 \exp(-1.53\text{ev/kT})$ between 320°C and 550°C



$I^{131}$  in CsI  $D = 2.05 \exp(-1.37\text{ev}/kT)$   
between  $410^\circ\text{C}$  and  $540^\circ\text{C}$   
and  $D = 0.487 \exp(-1.28\text{ev}/kT)$   
between  $300^\circ\text{C}$  and  $410^\circ\text{C}$ ,  
where the units for  $D$  are  $\text{cm}^2 \text{sec}^{-1}$ .

The conductivities in  $\text{ohm}^{-1} \text{cm}^{-1}$  are given by:

CsBr  $\sigma = 2.48 \times 10^5 \exp(-1.435\text{ev}/kT)$   
between  $475^\circ\text{C}$  and  $590^\circ\text{C}$   
 $\sigma = 2.51 \times 10^4 \exp(-1.285\text{ev}/kT)$   
between the impurity region and  $475^\circ\text{C}$   
and  $\sigma = 1.87 \times 10^3 \exp(-1.165\text{ev}/kT)$   
below  $290^\circ\text{C}$  for a crystal with no apparent impurity region.

CsI  $\sigma = 2.21 \times 10^5 \exp(-1.43\text{ev}/kT)$   
between  $480^\circ\text{C}$  and  $595^\circ\text{C}$   
and  $\sigma = 1.38 \times 10^4 \exp(-1.25\text{ev}/kT)$   
between the impurity region and  $480^\circ\text{C}$ .

Above the highest temperature listed for each salt the conductivities have no simple expressions. At temperatures below that at which the impurity-controlled conductivity is predominant the conductivity curves had slopes corresponding to enthalpies from 0.51ev to 0.59ev for both salts. Conductivity measurements on CsBr doped with  $\text{Cs}_2\text{S}$  and with  $\text{BaBr}_2$  indicate that these impurities are so insoluble in the lattice that experiments on doped crystals may prove difficult to perform.

It is concluded that ionic transport is responsible for nearly all of the observed conductivity of both CsBr and CsI, but the mechanisms by which the ions move cannot be determined from these experiments. Schottky defects seem likely from energy considerations, and reasonable and consistent values for the formation enthalpy of a Schottky defect are obtained from the experiments on CsBr. Simple vacancy motion in each sub-lattice probably cannot alone account for the ionic transport since detailed agreement between the conductivity and the diffusion coefficients is not obtained in the Nernst-Einstein relation using the correlation factor appropriate for vacancies. Several additional mechanisms are discussed. The halogen ions seem to move by at least two mechanisms. Unlike the alkali halides of the NaCl structure, CsBr and CsI contain both mobile cationic defects and mobile anionic defects, the latter contributing more to the ionic transport properties.

Microfilm \$2.00; Xerox \$4.20. 78 pages.

#### NEW DERIVATION OF ELASTIC EQUATIONS FOR QUARTZ CRYSTALS

(L. C. Card No. Mic 58-2121)

Kozaburo Miyakawa, Ph.D.  
Colorado State University, 1957

The conventional equations of elasticity are derived with the help of the idea of strain and stress, which have never been explained rigorously in terms of molecular quantities. It is also known that solutions of most of the problems in elasticity are practically impossible to obtain. With respect to the above two difficulties, reexamination of basic derivations of elastic equations has been necessary in the last several decades. The study of this disser-

tation is to present a rigorous derivation of elastic equations, starting with the fewest assumptions which are perfectly justified from the stand-point of the molecular physics.

Based upon the potential energy due to interaction between unit cells in a crystal, a new derivation of differential equations of elasticity is developed, with a particular concern for the trigonal holoaxial class of crystal symmetry. The new theory does not require such assumptions as used in the conventional derivation. Instead, one of the consequences shows that simple translatory movements and rigid body rotations have no effect on the equations.

The new derivation achieves two objects: First, it gives in more satisfactory fashion physical meaning to each term in the differential equations. Secondly, it provides more insights to the microscopic nature of the equations, so that more exact information about intermolecular structure may be obtained.

The difficulty of interpreting the nature of the forces acting in the conventional equations is solved by the new derivation. In addition to the central force, it is found necessary to introduce a new force, which acts in a direction perpendicular to the direction of central force. It is further found that the new force has a restricted centroidal symmetry, in addition to the spherical and trigonal holoaxial symmetries. If only central forces are assumed, the Cauchy relations are, of course, obtained by the new derivation. One of the consequences of the new derivation suggests the introduction of new constants, instead of the conventional elastic coefficients in order to understand the symmetrical properties of the differential equations.

Microfilm \$2.00; Xerox \$4.20. 76 pages.

#### ASPECTS OF MOLECULAR STRUCTURE OF ETHYL ALCOHOL AND THE DESIGN, CONSTRUCTION, AND OPERATION OF A STARK MODULATED MICROWAVE SPECTROGRAPH

(L. C. Card No. Mic 59-838)

George Edward Schafer, Ph.D.  
University of Colorado, 1958

Supervisor: Professor Donald G. Burkhard

A Stark modulated microwave spectrograph was designed, constructed, and tested. The completed instrument had the following characteristics: Stark field of 20 kc/s and 0 to 405 volts amplitude; frequency range of 18.0 to 26.5 kMc/s; sensitivity of  $3 \times 10^{-10} \text{cm}^{-1}$ ; frequency measurement accurate to 1 part in  $10^6$ ; resolution of approximately 0.1 Mc/s; samples taken as vapor from liquids or taken from the gaseous state; and adaptability to any frequency range below 40.0 kMc/s. The frequency range has since been extended downward to 12.4 kMc/s by other workers. A set of instructions were prepared to facilitate the use, maintenance, and repair of the components of the spectrograph.

This instrument was used to examine ethyl alcohol for Stark sensitive absorption lines in the frequency range of 12.4 to 26.5 kMc/s. The frequency range of 18.0 to 26.0 kMc/s was systematically searched at relatively high sensitivity, while the remainder of the frequency range was



examined for relatively intense absorptions. A number of absorption lines had Stark components which could be resolved, and the rotational transitions of these lines were tentatively identified. These absorptions were then examined again, and a tentative analysis of the spectrum was made. From this analysis, the following provisional molecular constants were determined for ethyl alcohol;  $A = 33,326.64$  Mc/s,  $B = 9112.85$  Mc/s,  $C = 8019.38$  Mc/s,  $\kappa = -0.913576$ ,  $\mu_a = 1.18$ D, and  $\mu_b = 1.37$ D, where  $A$ ,  $B$ , and  $C$  are the rotational constants associated with the least, intermediate, and greatest moments of inertia, respectively,  $\mu_a$  and  $\mu_b$  are the components of the dipole moment along the axes of the least and intermediate moments of inertia, respectively, and  $\kappa$  is Ray's asymmetry parameter. Microfilm \$2.60; Xerox \$9.00. 197 pages.

#### NUCLEAR QUADRUPOLE EFFECTS IN BORON COMPOUNDS

(L. C. Card No. Mic 59-303)

Arnold H. Silver, Ph.D.  
Rensselaer Polytechnic Institute, 1958

Adviser: P. J. Bray

The methods of nuclear magnetic resonance are applied to an investigation of the structure and electronic configuration of boron-containing solids. The electric quadrupole interaction of  $B^{11}$  nuclei with the electric field gradient has been studied in metal borides, boron-nitrogen systems, boron-oxygen systems, borohydrides and borofluorides, boron carbide and boron-oxide glasses. The Townes and Dailey method of estimating the quadrupole coupling constant is used in conjunction with the experimental results to assign bonding configurations in these materials. With the exception of boron carbide, single crystals were not available and the experiments were performed with powdered samples. A study of a boron carbide single crystal revealed a structural anomaly previously unobserved. Measurements of the boron quadrupole coupling constants in boron oxide glasses reveal that the "boron oxide anomaly" is associated with a change in coordination and bonding electron configuration of the boron atoms. The general principle of glass network formers and modifiers is supported by this research.

Microfilm \$2.30; Xerox \$8.20. 176 pages.

#### ANALYSIS OF EXCHANGE DYNAMICS IN PURE ETHANOL USING NUCLEAR MAGNETIC RESONANCE DATA

(L. C. Card No. Mic 59-816)

Irving Weinberg, Ph.D.  
University of Colorado, 1958

Supervisor: Associate Professor Wesley E. Brittin

The high resolution nuclear magnetic resonance spectrum of ethanol is utilized in a study of molecular exchange

between the associated and single states of the pure liquid. As a basis for analysis of the exchange, a two-state model is used in which single molecules and uniformly sized polymers are assumed to exist. The phenomenon studied is the environmental exchange between monomers and single molecules formed into associated groups. The exchange takes place when a collision of sufficient energy occurs between a monomer and a polymer.

From the existing nuclear resonance data on pure ethanol a value for  $\gamma$ , the mean lifetime between exchange events, is obtained.  $\gamma$  is then related to the molecular exchange between monomeric and polymeric states. Explicit expressions are obtained for the exchange rate in terms of  $\gamma$  and the fraction of hydroxyl protons in both the single and associated states. The exchange rate is then determined from a kinetic analysis based on the Fowler-Slater model of the liquid state.

This model is first modified to obtain closer agreement with the available experimental evidence from infra-red and viscosity studies. The exchange rate obtained from the nuclear resonance data is then equated to the rate of exchange determined from an analysis based on the modified liquid-state model. A direct result of this procedure is the determination of  $P_C$ , the probability of reaction per collision and  $P_E$ , the probability of reaction per encounter. It is found that  $P_E = 1.2 \times 10^{-11}$  per encounter, and  $P_C = 1.3 \times 10^{-12}$  per collision.

The exchange between associated and single states is then studied using the theory of absolute reaction rates and the Eyring theory of viscosity. If one equates  $P_C$  with the transmission coefficient in the former theory, then a free energy of activation for the exchange process may be determined. This free energy is approximately the same (within 1.6%) as the free energy of activation for viscous flow obtained from the Eyring theory of viscosity. The activated state in each case takes the form of a collision between a monomer and a polymer in the immediate presence of a hole. This result lends supporting evidence to the hypothesis that the monomer is the unit of viscous flow in ethanol. Finally, it is concluded that the probability of occurrence of a viscous jump is much greater than the probability of exchange between the associated and single states of the ethanol. The methods used in obtaining these results are general and appear to be applicable to alcohols other than ethanol.

Microfilm \$2.00; Xerox \$6.80. 141 pages.

#### ANOMALOUS DIFFUSION OF RARE EARTH METALS IN SILVER AND LEAD

(L. C. Card No. Mic 59-64)

George Patteson Williams, Jr., Ph.D.  
The University of North Carolina, 1958

Supervisor: L. M. Slifkin

The investigation of the diffusion of rare earth tracers in silver and lead was initiated to evaluate the size effect in diffusion properties. For the geometry used, Fick's law predicts a linear relation after diffusion between the logarithm of the tracer concentration ( $c$ ) and the square of the distance ( $x^2$ ) in from the surface. The results deviate



strongly from this behavior, to the extent that the evaluation of the size effect is probably impossible using this system.

The plots of  $\log c$  versus  $x^2$  for the diffusion of Ce, Pm, and Nd in Ag and Pb at temperatures near the melting point of the solvent show a very steep initial slope corresponding to a diffusion coefficient,  $D$ , of approximately  $10^{-12}$  to  $10^{-13}$   $\text{cm}^2/\text{sec}$ . This is followed by a flatter region of much greater penetration but containing very little of the tracer.

This anomalous diffusion is unquestionably structure sensitive, and has been consistently observed in single as well as polycrystals and at tracer concentrations as low as  $10^{-6}$  to  $10^{-9}$  atomic fraction. This indicates a probable dependence on the number and extent of dislocations present. Since the ionic radii of the rare earths are approximately twice that of Ag, strong segregation at dislocations, even at exceedingly dilute concentrations, is expected. Hence, the dislocations should be effectively tied down, and the plasticity greatly reduced. Such mechanical effects have been observed.

Microfilm \$2.00; Xerox \$3.60. 65 pages.

## PHYSICS, ELECTRONICS & ELECTRICITY

### CRITICAL FIELD MEASUREMENTS ON SUPERCONDUCTING LEAD ISOTOPES

(L. C. Card No. Mic 59-496)

Daniel Lorenzo Decker, Ph.D.  
University of Illinois, 1958

The measurement of the isotope effect upon the superconducting critical field of lead has been extended to temperatures well below  $T_c$ . In connection with this measurement the nature of the superconducting transition in lead has been studied and an accurate superconducting critical field curve for lead is reported.

The study of superconducting transitions in lead reveal a strongly temperature dependent hysteresis which disappears near  $T_c$ . An experimental criterion for distinguishing between "reversible" and "irreversible" transitions is presented and methods of specimen preparation are discussed whereby specimens will have most nearly ideal transitions.

Very precise measurements of the critical field curve for lead between  $1.28^\circ\text{K}$  and  $T_c$  have been made. All pure lead specimens with a superconducting transition free from or corrected for hysteresis have the same critical field curve with

$$H_0 = 802.6 \pm 0.4 \text{ gauss}$$

$$\text{and } (dH_c/dT)_{T=T_c} = -238.4 \pm 1.2 \text{ gauss}/^\circ\text{K}.$$

The critical field curve for lead is not parabolic but deviates above a parabola (passing through  $H_0$  and  $T_c$ ) by as much as 2.35 percent. Most other superconductors which have been measured deviate below a parabolic shape.

The measured critical field curve is expanded as a function of  $T^2$  and used in calculating the thermodynamic

properties of lead. The values for the coefficient of the electronic specific heat in the normal state ( $3.06 \pm 0.04$  millijoules/mole-deg<sup>2</sup>) and for the latent heat of the superconducting transition are in good agreement with calorimetric measurements. The electronic specific heat in the superconducting state does not show an exponential  $1/T$  dependence but rather shows a close resemblance to a  $T^4$  dependence below  $5^\circ\text{K}$ .

Measurements of the isotope effect upon the critical field below  $T_c$  show small differences in the coefficient of the normal electronic specific heat,  $\gamma$ , between specimens but in general give support to the principle of similarity in lead to about the same precision as has been measured for other superconductors. It is possible that the small differences in  $\gamma$  are due to impurity effects which is considered the main source of uncertainty in the isotope measurements.

Microfilm \$2.00; Xerox \$4.60. 90 pages.

## PHYSICS, METEOROLOGY

### A METEOROLOGICAL INTERPRETATION OF WAVELENGTH DEPENDENCE IN TRANSHORIZON PROPAGATION

(L. C. Card No. Mic 59-676)

Ralph Bolgiano, Jr., Ph.D.  
Cornell University, 1958

Recent radio data indicate that the wavelength dependence of uhf transhorizon propagation varies widely in time. This is in contradiction with all theoretical explanations previously put forth. Each attempt to account for the underlying effects of ever-present atmospheric motions has, in the past, pointed toward a unique form of the dependence. Extensive discussions have resulted as to the validity and relative merits of the various forms; but at no time has a variable wavelength dependence been proposed.

Since scatter propagation theory has predicted so satisfactorily the broad aspects of the radio signals, it is retained as the basis for further analysis. A new model is developed for the structure of refractive index fluctuations induced by turbulence. Grounded on a theory of homogeneous turbulence in a stably stratified atmosphere, which is propounded here in some detail also, this new model provides an explanation for the observed distribution of wavelength dependence. It suggests that at times when the dynamic stability of the air within the scattering volume is neutral, the received power should be nearly independent of radio wavelength. On the other hand, when the atmosphere is dynamically stable, the signal strength should be proportional to the square, or higher power, of the wavelength.

These predictions have been tested by comparing the results of a scaled-frequency experiment with simultaneous meteorological data gathered along the path. Richardson's number for the 1 to 3 km. layer, within which the principal scattering volume lies, has been employed as an index of dynamic stability, though it falls short of ideal in some respects. The 0.8 value of correlation found between



Richardson's number and the wavelength dependence is highly suggestive that a relation of the nature predicted does, in fact, exist.

Microfilm \$2.00; Xerox \$5.40. 108 pages.

## PHYSICS, NUCLEAR

### RELATIVISTIC EFFECTS IN THE TWO-BODY CURRENT OPERATOR

(L. C. Card No. Mic 59-250)

Richard Blankenbecler, Ph.D.  
Stanford University, 1958

The covariant formulation of the two-body problem is derived and discussed with a view to obtaining the relativistic corrections to the Schrödinger current operator. It is explicitly shown that the covariant formulation reduces to the Schrödinger formulation in the nonrelativistic limit.

It is proved that the use of folded nucleon and nuclear form factors is correct for electron-scattering if exchange effects are neglected. It is further shown that the finite size of the nucleon does not affect any real photon process. A qualitative discussion of the approximations implicit in the present theoretical treatment of the deuteron is presented.

The calculation of the elastic scattering form factor is presented for two covariant deuteron models and compared with the nonrelativistic results. An improved sum rule which relates the total elastic and inelastic scattering of electrons from the deuteron to the free electron-nucleon cross sections is derived. It has the property of reducing to the correct relativistic result upon neglect of binding.

Microfilm \$2.00; Xerox \$5.00. 97 pages.

### GAMMA-RAYS FROM DEUTERON REACTIONS

(L. C. Card No. Mic 59-253)

Lloyd Fremont Chase, Jr., Ph.D.  
Stanford University, 1958

A survey of the gamma-rays produced by deuteron induced reactions has been made using the 2.8-Mev deuterons from the Stanford cyclotron. The gamma-rays were detected by means of a three crystal scintillation pair spectrometer, the gamma-ray spectra being displayed on an electronic twenty channel pulse height analyzer. The gamma-ray pair line distributions and the relative gamma-ray pair detection efficiencies are discussed. A discussion of the pulse height analyzer, including circuit diagrams, is also given.

Over one hundred and twenty-five gamma-rays, which are primarily from the (d,p) and (d,n) stripping reactions, are tabulated. These gamma-rays are assigned to transitions between levels in the residual mirror nuclei  $B^{11}$ ,  $C^{11}$ ,  $C^{13}$ ,  $N^{15}$ ,  $O^{15}$ ,  $Mg^{25}$ ,  $Si^{29}$ ,  $S^{33}$  and from the residual nuclei  $Be^{10}$ ,  $B^{10}$ ,  $C^{12}$ ,  $Ne^{20}$ ,  $F^{20}$ ,  $Si^{28}$ ,  $Al^{28}$ .

Where possible, the gamma-ray assignments are discussed in terms of nuclear models -- e.g. the alpha-particle model for  $C^{12}$ , the collective model for  $Mg^{25}$ . Also, the relative Weisskopf electromagnetic transition probabilities estimates are compared to the gamma-ray branching from particular levels in  $Si^{29}$ ,  $Be^{10}$ ,  $B^{10}$  and  $C^{12}$ .

Analog states of ( $B^{11}$ ,  $C^{11}$ ), ( $C^{13}$ ,  $N^{13}$ ), ( $N^{15}$ ,  $O^{15}$ ), ( $Mg^{25}$ ,  $Al^{25}$ ), ( $Si^{29}$ ,  $P^{29}$ ), ( $S^{33}$ ,  $Cl^{33}$ ), ( $Be^{10}$ ,  $B^{10}$ ,  $C^{10}$ ), ( $B^{12}$ ,  $C^{12}$ ,  $N^{12}$ ) are searched for by their energy level positions and their decay properties. These analog states are shown by connecting dotted lines on the appropriate decay schemes.

Similarities of relative gamma-ray yields from residual nuclei formed by the (n, $\gamma$ ) and (d,p) reactions are observed in ( $C^{13}$ ),  $N^{15}$ ,  $Mg^{25}$ ,  $S^{29}$  and  $S^{33}$ . Qualitative arguments are given for such similarities using the concepts of fractional parentage.

Microfilm \$2.15; Xerox \$7.60. 164 pages.

### I. ISOMERS IN $Tb^{158}$ AND $Ho^{163}$ II. DECAY SCHEME OF $Mo^{91}$

(L. C. Card No. Mic 58-5420)

Norwood Babcock Gove, Ph.D.  
University of Illinois, 1958

$Tb^{158}$  and  $Ho^{163}$  were produced by ( $\gamma$ ,n) and ( $\gamma$ ,2n) reactions, respectively, on the stable isotopes, using x-rays from the Illinois 22-Mev betatron. The resulting isomeric transitions have been studied with NaI crystals, proportional counter, and an RIDL 100-channel analyzer. A pneumatic tube was used to transfer the source from the betatron to the detector. For the  $Tb^{158}$  isomer the half-life is  $10.5 \pm 0.3$  seconds and the gamma ray energy is  $111 \pm 2$  kev. X-rays present were confirmed to be those of Tb by comparison with x-rays of Hf, Sm, and Gd, employing a proportional counter. By comparison of the gamma ray with the Tb x-ray the K-conversion coefficient was found, after correction for fluorescence yield, detector efficiency, and self-absorption in the metallic source, to be  $61 \pm 9$ . This, together with the half-life, favors an M3 assignment to the transition. For the 0.8 second  $Ho^{163}$  isomer the gamma ray energy is  $299 \pm 2$  kev by comparison with  $Eu^{152}$ ,  $Hg^{203}$ ,  $Cr^{51}$ , and  $Sn^{113}$ . The K-conversion coefficient is  $0.17 \pm 0.06$ , indicating an E3 transition. These results are consistent with the theories of Nilsson and Gottfried.

$Mo^{91}$  was made in the betatron by a ( $\gamma$ ,n) reaction on unseparated Mo foils. Gamma-radiation energies were measured at  $1540 \pm 20$ ,  $1210 \pm 30$ , and  $658 \pm 3$  kev., all of which decay with the known 65.5 second half-life. Three positron groups involved in the same decay have end-points  $3.99 \pm 0.05$ ,  $2.78 \pm 0.10$  (in coincidence with the 1210 kev gamma) and  $2.48 \pm 0.10$  Mev (in coincidence with the 1540 kev gamma). No gamma radiation was found with the 15-minute half-life. A single positron group with this longer half-life was found to have an end-point of  $3.44 \pm 0.03$  Mev. The long-lived positrons represent a transition between the ground states of  $Mo^{91}$  and  $Nb^{91}$ , whereas the 65-second positrons proceed from a 658-kev excited state of  $Mo^{91}$  to three excited states of  $Nb^{91}$ , the lowest of which is the well-known 104-kev excited state. The levels in  $Nb^{91}$  are designated: ground state, g 9/2; 104 kev level, p 1/2; 1314 kev level, p 1/2 or p 3/2; 1644 kev level, p 1/2 or p 3/2.

Microfilm \$2.00; Xerox \$4.60. 90 pages.



A STUDY OF THE ABUNDANCE  
AND ISOTOPIC RATIO OF HELIUM  
IN THE ATMOSPHERE AND IN METEORITES

(L. C. Card No. Mic 59-1313)

John H. Hoffman, Ph.D.  
University of Minnesota, 1958

Helium is produced in meteorites by the interaction of cosmic rays with the nuclei of the meteorite material. High energy protons can transfer large quantities of energy to struck nuclei by the creation and absorption of  $\pi$  mesons in the nucleus. Among the methods of deexcitation of such a highly excited nucleus is spallation, which consists of the evaporation of low mass nuclei, including  $H^3$ ,  $He^3$  and  $He^4$ , from the nucleus.

In order to study this phenomenon, the helium distribution in two large 1/2 ton iron meteorites was measured. The Carbo and the Grant meteorites were each cut in half and a slice was removed (parallel to the cut surface) from each meteorite. These slices were cut into a number of bars, and samples from each bar were analysed for  $He^3$  and  $He^4$  content.

A double focusing mass spectrometer was constructed for this project. Samples of about 0.150 gm were melted in an induction furnace. The gas thus released was purified by a titanium sponge getter and the helium from the meteorite was measured by means of the mass spectrometer using the recirculation technique. Standard mixtures of  $He^3$  and  $He^4$  were used to calibrate the mass spectrometer.

The  $He^3$  and  $He^4$  contents of samples from the various bars were plotted as a function of position of sample in the bar. These points were connected by a smooth curve. From these data, contours of constant  $He^3$  and constant  $He^4$  were plotted on a map of the slice from each meteorite. The Grant meteorite contours were closed curves with a minimum helium content near the center of the meteorite slice. The  $He^3/He^4$  ratio also had a minimum value, 0.26, at the center and increased to 0.30 at one of the surfaces. From these closed contours the average radial helium content of the meteorite slice was plotted and an analysis was made of these data.

An equation, which represents the helium production rate at a distance  $X$  below a semi-infinite plane surface exposed to a normally incident cosmic ray flux, was developed. By integrating this equation around a sphere, an equation representing the radial helium production rate in a spherical model of a meteorite was obtained. The parameters of this equation were adjusted to make the equation fit the radial helium distribution of the Grant meteorite. The result showed that on the average the ratio of the post-atmospheric to pre-atmospheric radii of the Grant meteorite was 0.65, the pre-atmospheric radius being 39 cm. Also, the ratio of  $He^3/He^4$  produced by primary cosmic rays is 0.50 while that by secondary cosmic rays is 0.14. In addition, primary and secondary cosmic ray interaction cross sections were obtained.

The Carbo meteorite contours were not closed curves, suggesting that this meteorite may have split late in its life time. The  $He^3/He^4$  ratio in Carbo remains nearly constant at 0.24 throughout the slice, again indicating that the piece we have is only part of a larger body.

Helium was extracted from the atmosphere by the use of activated charcoal at liquid nitrogen temperature. The

$He^3/He^4$  ratio of atmospheric helium was measured against standards with the mass spectrometer. This value for ground level air was  $1.371 \times 10^{-6}$  and showed no change to 0.5% in air from about 32 km. The absolute amount of helium in air, measured by isotope dilution, was  $5.20 \times 10^{-6}$  cc/cc and again was the same to 2% at 32 km. This indicates the atmosphere is well mixed up to altitudes of at least 32 km. Microfilm \$2.00; Xerox \$4.80. 95 pages.

RELATIVE CROSS SECTIONS AT SMALL ANGLES  
FOR PHOTOPRODUCTION OF POSITIVE  $\pi$ -MESONS  
FROM HYDROGEN

(L. C. Card No. Mic 59-276)

Alan Jay Lazarus, Ph.D.  
Stanford University, 1958

Relative measurements were made of the angular dependence of the cross section for production of  $\pi^+$ -mesons from hydrogen in the angular range  $7^\circ \leq \theta_{c.m.} \leq 27^\circ$  by photons of energies 220, 300, 350, and 390 Mev. In addition, the relative energy dependence of the cross section was measured at  $\theta_{c.m.} = 20^\circ$  for photons of the same energies.

The results are compared with calculations of dispersion theory for various values of the coupling constant and resonance energy. The results agree with the dispersion-theory predictions in the angular range covered by this experiment except for the relative angular dependence at 390 Mev. The agreement of the dispersion-theory calculations and the results of experiments outside the range covered by this experiment is shown to be poor.

Microfilm \$2.00; Xerox \$4.80. 92 pages.

PHOTOPRODUCTION OF NEUTRAL PIONS  
IN HYDROGEN

(L. C. Card No. Mic 59-546)

George Edward Modesitt, Ph.D.  
University of Illinois, 1958

The photoproduction of neutral pions from hydrogen was studied by counting one of the decay gamma rays in a telescope of scintillation counters. The pions were produced in a liquid hydrogen target which was irradiated by the University of Illinois 300 Mev betatron. Gamma counting rates were obtained for the energy range 135-295 Mev in 10 Mev steps for telescope angles of  $40^\circ$ ,  $65^\circ$ ,  $90^\circ$ , and  $145^\circ$ .

The telescope gamma detection efficiency was evaluated with a Monte Carlo calculation on the Illiac. The photon spectrum was unfolded from the activation data by a process analogous to the least squares method for numerical solution of integral equations. The Borsellino relations between single gamma counting rates and photo-pion cross sections were used to make a least squares fit of the data at the four angles to determine the three coefficients in the p-wave expansion of the cross section.

The interference coefficient  $B$  was found to be negative



throughout the energy range considered with a minimum value of approximately  $-1.4$  microbarns/steradian near 270 Mev. The ratio  $-C/A$  increased from near zero at 170 Mev to 0.58 at 280 Mev. The total experimental error was estimated to be about 10% and was primarily the result of uncertainties in the efficiency calculation.

The results disagreed with theoretical calculations based on dispersion relations and the cut-off model in that the magnitudes of the measured coefficients were significantly larger. There is some indication that better agreement would be obtained if electric quadrupole contributions were included in the theoretical calculations.

Microfilm \$2.00; Xerox \$4.40. 82 pages.

#### DIFFERENTIAL CROSS SECTIONS FOR THE SCATTERING OF MEDIUM ENERGY PROTONS ON CARBON\*

(L. C. Card No. Mic 58-7875)

Robert W. Peelle, Ph.D.  
Princeton University, 1958

Extensive experimental results are presented showing the variation with energy of the absolute differential cross sections for the elastic and inelastic scattering of medium energy protons on carbon. For the scattering with  $Q = 0$  and  $Q = -4.4$  Mev, angular distributions between 20 deg and 170 deg were obtained for eleven incident proton energies spaced between 14.0 and 19.4 Mev. Distributions for scattering leading to the excitation of the 7.7 Mev and 9.6 Mev states of  $C^{12}$  were measured at energies of 16.7, 17.8, and 18.9 Mev. Current theories of medium energy elastic and inelastic nucleon scattering are discussed, with emphasis on the angular distributions expected from light nuclei, and the experimental results are qualitatively discussed in their relation to these theories. The elastic scattering cross sections show diffraction effects corresponding to what might be expected from the complex potential theory. The predominant inelastic scattering is forward, though the angular distributions corresponding to the three levels studied do not resemble each other. In no single case is one of these distributions symmetrical about 90 deg. Simple Bessel-function distributions given by the first-order direct-interaction theory do not agree well with the data, but only the scattering leading to the 4.4 Mev level of  $C^{12}$  appears to indicate thorough disagreement.

Experimental differential cross sections as a function of energy are presented for the scattering of protons on hydrogen near 90 deg c.m.

Microfilm \$2.45; Xerox \$8.60. 186 pages.

\*This work was supported by the U. S. Atomic Energy Commission and by the Higgins Scientific Trust Fund.

#### A STUDY OF LOW LYING EXCITED LEVELS OF PALLADIUM-105

(L. C. Card No. Mic 59-873)

Alan Rosen, Ph.D.  
University of Southern California, 1958

Chairman: Professor H. H. Forster

The radiation emanating from Ruthenium metal which had been irradiated with neutrons has been investigated with a thin lens beta ray spectrometer, a scintillation spectrometer, and a coincidence scintillation spectrometer. The major activity in the sample was due to Ruthenium-103 and Rhodium-105. The objective of the experiments was to identify the radiation emanating from the decay of Rhodium-105 and study the excited states of the daughter nucleus Palladium-105.

The decay of Ruthenium-103 has been studied in this laboratory prior to this time, and the contribution of this isotope to the total activity could therefore be taken into consideration. As for Rhodium-105, which has been studied extensively by other investigators, the experimental observations of the various investigators were not in agreement, and not all the observed gamma rays could be fitted into a consistent decay scheme.

The beta spectrum was studied with the double thin lens beta ray spectrometer. After subtracting that portion of the beta spectrum which was due to Ruthenium-103, a Fermi analysis of the remaining spectrum showed two beta groups of end point energy  $265 \pm 20$  Kev and  $560 \pm 20$  Kev. A third beta group of end point energy  $420 \pm 70$  Kev was consistent with the experimental data. Gamma rays were observed with the beta ray spectrometer through external conversion in a 52 mg/cm<sup>2</sup> lead radiator, and with the scintillation spectrometer equipped with a two-inch diameter, two-inch long NaI (Thallium activated) crystal. The energies which could be attributed to Rhodium-105 were  $220 \pm 5$  Kev,  $315 \pm 3$  Kev, and  $415 \pm 3$  Kev.

Gamma-gamma and beta-gamma coincidence experiments were performed. In the gamma-gamma coincidence experiments two NaI crystals were arranged in a 180-degree geometry. A pulse height analyzer in each branch of the circuit was used to select the gamma rays. Coincidences were observed between the 315 Kev gamma ray and gamma rays of energy 220, 310, 415, and 550 Kev. The 415 Kev gamma ray was not in coincidence with the 220 Kev gamma ray.

In the beta-gamma coincidence experiments a thin plastic scintillator was used in the beta detecting branch. With the gamma branch of the coincidence spectrometer set on a given gamma ray, it was possible to obtain a spectrum of the beta rays which were in coincidence with the specific gamma ray. The 220, 315, and 415 Kev gamma rays were found to be in coincidence with beta groups of end point energy  $350 \pm 50$  Kev,  $550 \pm 100$  Kev, and  $200 \pm 100$  Kev respectively.

The decay scheme most consistent with the observed data differs considerably from the decay schemes previously associated with Rhodium-105. The major change was due to the three newly discovered gamma rays which were in coincidence with the 315 Kev gamma ray. One of the major ambiguities in the old decay scheme was the disagreement as to whether the 315 Kev gamma ray was in coincidence with the hard or soft beta component. With



the discovery of two gamma rays of energy 310 and 315 Kev, and the analysis of the beta groups which were in coincidence with the 315 Kev gamma ray, this ambiguity has been resolved. It was concluded that the 310 Kev gamma ray was in coincidence with the soft beta group while the 315 Kev gamma ray was in coincidence with the hard beta group. Prior to this work only one excited level of Palladium-105 was believed to arise from the decay of Rhodium-105. The proposed decay scheme embodies four excited levels in Palladium-105. Energy, spin, and parity assignments are discussed and the results considered in terms of the shell model of nuclear structure.

Microfilm \$2.00; Xerox \$7.00. 149 pages.

#### THE DENSITY DEPENDENCE OF PHOTONS OF DEGRADED ENERGY

(L. C. Card No. Mic 59-978)

David Fox Woods, Ph.D.  
Cornell University, 1958

The distribution of photons, emitted from a monochromatic point source and degraded in energy by Compton scattering in a homogeneous medium, must satisfy the linear form of the integro-differential Boltzmann equation. No exact solution is possible. However asymptotic solutions can be found for two cases.

In the case where the photons are trapped by the electrons of the material after losing energy in a collision and remain close to the point of energy loss, the density of photons at a distance  $r$  from the source of energy  $\gamma$  is

$$n(\gamma, r, d) = \frac{S_0 f(\gamma)}{4\pi r^2} e^{-rd\sigma_0},$$

where  $S_0$  is the source strength,  $\sigma_0$  is the Compton cross section for photons of initial (source) energy per electron and  $d$  the density of electrons per unit volume.

If, however, the photons of lower energy migrate freely, the scattering at lower energy where there is relatively little energy loss per collision cause the photons to seek a distribution independent of the initial energy, in particular

$$n(\gamma, r, d) = \frac{S_0 df'(\gamma)}{4\pi r} e^{-rd\sigma k}$$

where  $\sigma$  is the total cross section at energy  $\gamma$  and  $k$  is the solution of the equation

$$\frac{k}{\tanh^{-1} k} = C,$$

$C$  being the ratio of the scattering to total cross sections.

A more careful analysis following Bethe, Fano and Karr\* shows that multiple very small angle scattering in which very little energy loss occurs should modify the former of these expressions to read

$$n(\gamma, r, d) = \frac{S_0 f''(\gamma)}{4\pi r^2} [rd(\sigma_1 - \sigma_0)]^{K_0} e^{-\sigma_0 rd}$$

where  $K_0$  is a constant depending only on initial photon energy and  $\sigma_1$  is the cross section for the energy at which, on the average, the first large angular scattering occurs.

To resolve the question as to which form is valid, the author has undertaken a numerical calculation which shows that, except for the regions immediately adjacent to the source or a boundary, the distribution of photons of degraded energy follows that of the initial photons. Since the energy mesh used is unable to take into account multiple small angle scattering, this can be taken to prove that the last expression above is the correct form for the density dependence. Microfilm \$2.00; Xerox \$5.40. 106 pages.

\*Penetration and Diffusion of Hard X-rays through Thick Barriers. I the approach to spectral equilibrium. Bethe, Fano and Karr; Phys. Rev. 71, 1 (Aug. 15, 1947), p. 538.

#### PHYSIOLOGY

#### THE EFFECTS OF SUBLETHAL DOSAGES OF DDT UPON THE INSECTICIDAL TOLERANCE AND BIOTIC POTENTIAL OF A LABORATORY SUSCEPTIBLE STRAIN OF THE HOUSEFLY, MUSCA DOMESTICA L. (DIPTERA, MUSCIDAE)

(L. C. Card No. Mic 59-497)

William Kerlin Delaplane, Jr., Ph.D.  
University of Illinois, 1958

A study was made to determine the effects of a range of 0.1 to 0.6  $\mu\text{g}$ . per fly of sublethal dosages of DDT applied topically to 10 generations of housefly adults, and applied to adults that had been reared in larval medium impregnated with 2 PPM DDT, upon the resistance of succeeding generations to the compound.

A theory extant in the pest control industry holds that gradually lower chemical dosages bring on resistance

faster than a constant higher dosage. This investigation, using a susceptible strain of house fly, was initiated to ascertain, if possible, whether or not this theory is sound. More importantly, data were recorded to determine the effect of resistance on total oviposition, per cent of hatch, length of the larval period, per cent of pupation and mean length of adult female life.

The criteria used to measure resistance were the LD-50 values. These showed virtually no change for the first six generations, ranging from 0.3 to 0.38  $\mu\text{g}$ . per fly, in those series receiving adult topical application of one  $\mu\text{l}$ . per fly with no DDT in the larval medium. In those series receiving adult application following rearing in 2 PPM DDT in the larval medium there was a small increase, from 0.3 to 0.35  $\mu\text{g}$ . in the one-day age groups and from 0.35 to 0.45  $\mu\text{g}$ . in the five-day age groups in the first three generations, at the highest dosage of 0.6  $\mu\text{g}$ . per fly. At this same dosage, at the end of 10 generations in the former



series the level of resistance was 20 times, and in the latter series it was nearly 50 times. The check LD-50 values (reagent-grade acetone) remained constant in the former series, and in the latter series (2 PPM DDT in the larval medium) the resistance level was just two. Thus, all the series of this (Hazard) strain of flies lost susceptibility, i. e., acquired resistance, to DDT after nine generations of adult selection. Resistance levels declined in the 16th generation after five generations of no further exposure to DDT, but were not so readily lost in the series that had been reared with 2 PPM DDT in the larval medium.

The resistance levels did not decline as rapidly in the series of flies consistently treated at the five-day age groups as they did in the one-day (virgin) age groups of treatment, whether reared with no DDT in the larval medium or with 2 PPM DDT in the larval medium. Therefore, some resistance may be conferred by mating, or may be correlated with age per se.

It was concluded, therefore, that resistance develops more quickly, and increases faster, with increased dosages, and that it also increases faster with the combination of adult treatment and DDT-impregnation of the larval medium, resulting in a compounding effect for acquisition or resistance.

This investigation showed no correlation between acquisition of resistance and the per cent of hatch or the per cent of pupation. There were definite, positive correlations, however, between the acquisition of resistance and total oviposition, increased length of the larval stage and the mean length of adult female life. These were all more pronounced in the series reared with 2 PPM DDT in the larval medium, as opposed to the series where the adults only were treated.

The increased total oviposition of almost 200 per cent and the increased length of mean adult female life of nearly 60 per cent (and the former may be a result of the latter) at the highest levels of resistance, are not offset by the increased length of larval life. Thus, resistant flies will greatly outnumber susceptible flies, presuming all other factors are equal.

Microfilm \$2.00; Xerox \$3.00. 52 pages.

#### GAS TRANSPORT CHARACTERISTICS OF THE BLOOD OF MAMMALS OF DIFFERENT BODY SIZE

(L. C. Card No. Mic 59-998)

James Lynn Larimer, Ph.D.  
Duke University, 1959

Supervisor: Knut Schmidt-Nielsen

Three factors have been examined which are of importance in the rate of gas transport by mammalian blood. These are the oxygen dissociation characteristics, oxygen capacity, and carbonic anhydrase levels. The data have been correlated with existing knowledge of metabolic rates and certain circulatory and anatomical characteristics among mammals of different size.

The oxygen dissociation characteristics of the blood of mammals were found to be related exponentially to the body size. In one series of experiments,  $P_{50}$  (half saturation) values of the blood of nine species of mammals (weighing approximately 20 to 600,000 grams) were esti-

mated from two percentage saturation values using the Hill nomogram. A logarithmic plot of  $P_{50}$  versus body weight gave a straight line with a slope of  $-0.078$ . In a second series, the  $P_{50}$  values for seventeen species (also 20 to 600,000 grams) were obtained from complete oxygen dissociation curves. Similar treatment of these data also gave a linear relationship, but the slope was slightly less ( $-0.054$ ).

These relationships indicate that the unloading tension for oxygen is higher in the blood of small mammals than in large ones. These results, along with values for capillary density, diffusion rates, and diffusion distances, were analyzed in relation to the higher requirements for oxygen in small animals. The enhanced delivery of oxygen to the tissues of small animals may be accomplished by increasing the oxygen diffusion gradient in two ways: (a) shortening of the diffusion distance and expansion of the diffusion area by increasing capillary density and (b) increasing the tension difference between the blood and the tissues by increasing the unloading tension for oxygen.

Oxygen capacity data were obtained for the blood of seventeen species of mammals and related to the amount of photometrically determined hemoglobin. It was found that the oxygen capacity of the hemoglobin of all the species examined was essentially the same. If it is assumed that all the hemoglobins have the same molecular weight as human hemoglobin, this value was established as  $1.358 \pm 0.0558$  ml  $O_2$ /gm hemoglobin. This value could be used to derive the oxygen capacity from photometric hemoglobin data obtained from the blood of any of these seventeen species. The data show that no particular adaptations in oxygen capacity or hemoglobin levels have occurred in those mammals where enhanced metabolic rate is a size-dependent function.

Carbonic anhydrase activity was studied in the blood of twelve species ranging from 20 to 600,000 grams in weight. The red cells of most of the small animals were found to have a higher carbonic anhydrase activity than the red cells of the larger species. The relationship, when considered in terms of the requirements for  $CO_2$  transport, indicates that the enzyme is present in excess of the requirements even for the smaller animals with high metabolic rates. It was suggested that the enzyme could influence oxygen dissociation of hemoglobin due to a combination of the following factors: (a) small animals with high metabolic rates have the largest  $CO_2$  output and the largest amount of red cell carbonic anhydrase. (b) Small species also have very acid sensitive hemoglobins (marked Bohr effect). It is conceivable that the rapid hydration of carbon dioxide will permit a full utilization of the marked Bohr effect in the small animals during the short time the red cells remain in the tissue capillaries. In this way, the acid sensitive hemoglobins of small animals might release even more oxygen to the tissues than is accounted for by the existing oxygen gradient alone.

Microfilm \$2.00; Xerox \$6.40. 132 pages.



SEASONAL CHANGES IN THE RATES  
OF PHOTOSYNTHESIS AND RESPIRATION  
OF LOBLOLLY PINE AND WHITE PINE

(L. C. Card No. Mic 58-2741)

William H. Davis McGregor, Ph.D.  
Duke University, 1958

A 3rd listing. Please see page 2418 for abstract.  
Microfilm \$2.00; Xerox \$4.60. 89 pages.

WATER METABOLISM  
IN THE GROWING DOMESTIC FOWL

(L. C. Card No. Mic 59-688)

William Medway, Ph.D.  
Cornell University, 1958

The study of water metabolism by the domestic fowl at all stages of growth, from hatching to sexual maturity, was undertaken in order to establish normal values to be used as a baseline in later investigations involving electrolyte and hormonal disturbances.

Studies were conducted on females of the White Leghorn breed at 1, 2, 3, 4, 6, 8, 16 and 32 weeks of age. Total body water was determined by desiccation and the antipyrine dilution technique. Plasma volume was measured using Evans Blue Dye. Hematocrits were determined by the microcapillary technique. The extracellular space was obtained by use of the thiocyanate ion. From this data the blood volume, interstitial space and intracellular space were calculated. Feed and water consumption and water lost in the feces and urine were obtained by the use of a specially constructed apparatus. Total evaporative water loss was measured by making use of the Haldane respiratory calorimeter. Water balance was then determined.

Results obtained are presented as follows: the first figure in each case was that found in the one-week-old bird and the last figure that found in the 32-week-old hen. Total body water ranged from 72.8-57.3 percent of body weight. By the antipyrine dilution technique the range was 85.2-55.0 percent of body weight. The thiocyanate space decreased from 61.0-26.2 percent of body weight. Interstitial space dropped from 52.3-21.7 percent, intracellular space increased from 11.4-31.1 percent, plasma volume dropped from 8.7-4.6 percent, and blood volume declined from 12.0-6.5 percent of the body weight respectively. The hematocrit did not change significantly. Specific gravities of the whole blood and plasma did not change with age. Plasma water content dropped from 95.5-94.6 percent. The water drunk ranged from 2.1-3.6 ml/gm of feed consumed. Total excrement increased from 1.5-2.7 gm/gm of feed consumed. Total water intake ranged from 29.5 ml/bird to 495.9 ml/bird. Total water loss increased from 20.0 gm/bird to 406.9 gm/bird. Evaporative water loss in mgm/ml O<sub>2</sub> consumed ranged from 15.4 to 25.9. The birds were in a positive water balance throughout the studies.

Metabolism of water by growing female White Leghorn chickens has been studied. The total body water, thiocyanate space, interstitial space, blood volume, plasma volume and plasma water content decreased with age. The intracellular space, fluid intake, and fluid loss by all

routes increased with age. The hematocrit and specific gravities of blood and plasma did not change significantly. Microfilm \$2.00; Xerox \$5.60. 115 pages.

THE ROLE OF AVAILABLE CAPILLARY SURFACE  
AREA IN TRANSMURAL FLUID EXCHANGE RATES

(L. C. Card No. Mic 59-279)

Anthony Peter Moreci, Ph.D.  
Stanford University, 1958

This investigation is concerned with the role of available capillary area in filtration and diffusion exchanges. Under conditions of constant hydrostatic and osmotic pressures, the rate of fluid transfer across the capillary wall should vary as its surface area. Experiments to test this hypothesis have utilized the isolated ears of rabbits perfused with cell-free, colloid-saline mixtures under conditions which provided for constant perfusion pressure and continuous registration of flow rates. Net rates of filtration or absorption were ascertained indirectly by gravimetric means. Weight gain denoted net filtration while weight loss indicated net absorption. Manipulations of the fluid exchange area were accomplished by addition of known amounts of iron and norepinephrine to the perfusion medium. These agents have been shown to alter the tone of precapillary sphincters. The transfer of fluid effected by osmotic pressure differences (osmotic transients) were studied, with and without added iron, for the purpose of exploring the role of available area for exchanges. The possible interaction of iron and norepinephrine in smooth muscle were studied by comparing the effects produced on segments of rabbit ileum suspended in Tyrode's solution.

Increased rates of flow and weight gain were obtained during perfusion of media containing from one to four micrograms of ferrous iron (as FeSO<sub>4</sub>) per milliliter. The weight gain was due to accumulation of fluid in the extravascular compartment. The data suggest that one of the factors involved in the augmented fluid transfer rate is an increased filtration surface. Evidence to support this was obtained in microscopic observations of the capillary bed during perfusion of iron solution containing India ink. Appearance of the dark perfusate in areas which had previously shown no sign of flow suggested that new capillaries had been included in the active circulation. Other evidence indicates that the increased rate of fluid transfer is not secondary to increased capillary permeability.

Addition of enough glucose to the basic colloid-saline perfusate to raise its crystalloid osmotic pressure approximately twenty times above the perfusion pressure produced large losses of tissue weight. The data show that in eight of the nine experiments conducted, perfusion of iron-containing hypertonic solution resulted in considerably higher rates of weight loss than when iron-free hypertonic solution was used. This evidence indicates that the number of capillaries included in the active circulation and hence the area available for fluid exchange was greater in the presence of iron than in its absence.

Perfusion of media containing L-norepinephrine, with and without added iron, produced highly comparable losses of weight and decreases of flow rates initially. Subsequently, ears perfused with iron-norepinephrine gained



weight more rapidly than did ears perfused with iron-free norepinephrine, despite the fact that flow rates recorded at the outset in each case remained depressed at practically identical levels. A higher rate of norepinephrine inactivation in elements of the vasculature distal to the arterioles in the presence of iron is suggested.

Inhibition of the rhythmic contractions in rabbit and rat ileal segments were obtained by administration of either 4.0 micrograms of ferrous iron or 0.4 micrograms of L-norepinephrine. Both drugs injected simultaneously produced relaxation followed within seven seconds by vigorous contraction. Reversal of norepinephrine-induced inhibition of the gut was obtained by injection of iron, but iron-induced inhibition was followed by further relaxation on injection of norepinephrine. Inhibition produced by iron was reversed by acetylcholine. The significance of these observations is discussed.

Microfilm \$2.90; Xerox \$10.00. 221 pages.

#### PERIODISMS IN AMOUNT OF SPONTANEOUS ACTIVITY IN THE QUAHOG, VENUS MERCENARIA

(L. C. Card No. Mic 59-219)

Joan Shriner Palinscar, Ph.D.  
Northwestern University, 1958

The activity of Venus mercenaria was recorded continuously for ten 29-day periods during the four years

from 1954 through 1957, in order to study the hourly, daily and monthly variations in number of minutes open per hour, to find what cycles of solar and lunar frequencies existed and to discover possible correlations with external cycles.

Single-day cycles were found to show some characteristics of overt activity cycles, the major maximum of the day generally occurring during the daylight hours. Except for this one characteristic which nearly all had in common, the single-day cycles were not necessarily at all similar from day to day and showed a great variety of patterns.

In contrast, the 29-day diurnal cycles were quite similar in form, and all were found to be highly significant. The average range was about 45%. The cycles were generally unimodal in form, and the major maximum of the day tended to shift from morning to afternoon in alternate years.

The 29-day lunar-day cycles which were calculated had a range of only about 20%, and the individual cycles did not have points on the same curve which were significantly different from one another. A mean cycle for the four years did show, however, a significant maximum 3 to 6 hours after lunar zenith and a minimum about lunar nadir.

In view of the combination of seemingly overt components and statistical ones in the activity rhythm of Venus, an hypothesis is suggested which combines both endogenous and exogenous rhythmic control mechanisms.

Microfilm \$2.00; Xerox \$4.00. 72 pages.



## POLITICAL SCIENCE

### POLITICAL SCIENCE, GENERAL

#### CONTEMPT OF CONGRESS: A STUDY OF THE PROSECUTIONS INITIATED BY THE HOUSE COMMITTEE ON UN-AMERICAN ACTIVITIES, 1945-1957

(L. C. Card No. Mic 59-993)

Carl Beck, Ph.D.  
Duke University, 1959

Supervisor: Robert S. Rankin

In the thirteen years following the end of World War II, the Congress of the United States has manifoldly increased the number and scope of its investigatory committees. A concomitant of this expansion has been the increase in the number of prosecutions for contempt. The exercise by Congress of its coercive and punitive power to punish for contempt raises serious questions of constitutional law and public policy. This dissertation is concerned with the exercise of this power and the problems engendered by its use.

Although fourteen select, special, and permanent committees of Congress had initiated contempt proceedings in the period studied, the majority of cases stemmed from the House Committee on Un-American Activities. The behavior and function of this Committee and its use of the contempt process serves as the nucleus for this dissertation.

Following a discussion of the historical use and justification for the contempt process, each prosecution initiated by the Committee is analyzed as it proceeded through the Committee, the Congress and the courts. By extrapolating from this data, it is possible to evaluate the role of these three agencies. The Committee is criticized for the unrestricted range of its investigations, its denial of due process, and its refusal to adopt procedural safeguards for the protection of the reputations of those subpoenaed. It is also criticized for its use of the contempt process: little of the information denied by recalcitrant witnesses had any direct relation to the Committee's law making or supervisory functions.

The role of the Congress is also evaluated. Here it is noted that although the power to prosecute for contempt is inherent only in Congress itself and that Congress has the responsibility of supervising its various committees, Congress has acted upon each contempt citation in an automatic fashion.

Part of the rationale for this indifference is the belief that the courts will correct any injustice. There is some justification for this position: the courts have acquitted a majority of those cited. But at the same time, a close analysis of the opinions of the various courts demonstrates that they have acted with judicial restraint except when confronted with the plea of self-incrimination. In other cases, courts have demanded only that certain rudiments of due process be met.

A final evaluation of the contempt process since 1945

is then presented. As criteria for evaluation, it is postulated that an ideal citation would have one of two salutary effects. Either it would give the Congress the opportunity to review the demands of its committees and their function and behavior, or it would exert a coercive influence upon the recalcitrant witness. Neither of these results has been characteristic of the modern contempt process. Only three of the 226 witnesses cited have purged themselves and in no case has Congress overruled the decisions of its investigatory committees. This conclusion is all the more striking when compared with the results of the contempt proceedings initiated prior to 1945: of ninety-four persons cited for refusing to comply with the demands of a committee, thirty-two purged themselves and no action was taken against twenty-eight.

On the basis of this study of contempt citations, it is concluded that the modern process for citing for contempt is ineffectual. A return to the common law power of prosecuting by the exercise of Congress' summary power would have greater significance in eliminating the excesses of congressional investigations and better enable Congress to attain the information that is denied.

The appendices contain a synopsis of contempt citations from 1787 to 1958, the disposition of these cases, and a series of statistical comparisons.

Microfilm \$5.50; Xerox \$19.20. 429 pages.

#### PRESIDENTIAL POWER AND THE ROYAL PREROGATIVE

(L. C. Card No. Mic 58-7000)

Robert Louis Berg, Ph.D.  
University of Minnesota, 1958

Supervisor: Professor Harold W. Chase

The growth in power and influence of the American presidency constitutes one of the most remarkable features of our constitutional development. But if the authority and leadership inhering in the office are at times little short of awesome, the trend toward increasing executive power has been subject to criticism and expressions of alarm from 1789 to the present. At the least, our chief executives have been accused of expanding the powers beyond the limits intended by the Framers of the Constitution, at the worst the charge has been that executive actions have threatened to recreate the royal prerogative of a British king.

The royal prerogative has been defined as that body of autonomous executive power left to be exercised at discretion under the authority of the monarch. Critics of the modern presidency often contend that the powers of the office should include only those clearly granted in the Constitution and those given by Congress within the limits of its constitutional authority. A claim to a general



body of executive power above and beyond the specific grants is held to be a violation of the original intent of the Constitution.

Close examination of the views of the Framers of the Constitution makes it clear that they did not intend a Chief Executive with powers of the nature of the royal prerogative. British executive power as applied to the colonies had long been a source of grievance. With Independence the reaction was to so limit the governors of the states as to make explicit the rejection of anything like British executive authority. The same pattern appears in the limits and controls placed upon the Confederation Congress in the exercise of what were considered as its executive functions. The delegates to the Convention of 1787 were well aware that this background prohibited the creation of an executive that would appear to threaten a recrudescence of prerogative executive authority.

The proceedings of the Federal Convention give evidence that while the delegates were agreed upon the necessity to create a stronger executive than those subsisting in the states, they did not intend a prerogative executive. Most of the powers granted to the President had their counterpart in the grants given the governors of the states, or in those powers held by the Confederation Congress. The central theme in the building of the executive office was not to give the President powers of a content and nature different from these, but to make sure the powers would be applied independently of the encroachments of what was feared as an otherwise all-powerful national legislature. Views expressed during the contest over Ratification serve to support this interpretation.

Nevertheless the powers of the presidency have come to take on much of the force and content associated with the royal prerogative. Unwittingly the Framers created an office uniquely capable of meeting the crises which demand decisive action. More than this, it is the executive branch which is capable of providing the sense of direction without which Congress tends to lose its way. And, as his election has come to depend upon the direct expression of the popular will, it is the President from whom the public has come not only to expect but to demand leadership. Thus he has been expected to call forth resources not suspected to exist in the office. But these great powers have accrued not as the result of deliberate creation by the Framers, but as a matter of growth to which the office has proved fitted to respond.

Microfilm \$6.90; Xerox \$23.80. 542 pages.

**THE YOUNG OTTOMAN MOVEMENT: A STUDY  
IN THE EVOLUTION OF TURKISH POLITICAL  
THOUGHT IN THE NINETEENTH CENTURY**

(L. C. Card No. Mic 59-278)

Serif Arif Mardin, Ph.D.  
Stanford University, 1958

One of the problems of political theory which has not yet been systematically investigated is the process by which Western political conceptions have become accepted in countries having remained outside the main stream of Western political development. Turkey, which in the last century and a half has evolved from a theocratic state

into a lay constitutional republic is a concrete case for the need of such investigations. The Turkish Republic created in 1923 under the leadership of Kemal Ataturk was not established as the result of a sudden change of heart on the part of Turkish political leaders, but was the fruit come by a long evolution. One of the characteristics of this evolution has been the replacement of old Turkish conceptions and ideals of government by their Western equivalents, and a key point in this process has been the Young Ottoman Movement, active in Turkey from the early 1860's to the late 1870's. An investigation of the ideas of the Young Ottomans as well as an analysis of the extent to which they were influential and a survey of the problems they encountered on their way, is therefore the foundation on which other studies regarding the political westernization of Turkey will have to be laid. This dissertation attempted to achieve such a perspective.

The method used in trying to solve this problem was to survey the literature published by the Young Ottomans and in particular the ideas they expressed in their mouthpiece the *Hurriyet*. It was thus attempted to pinpoint the problems they tackled and the proposals they made their solution. The same was done for thinkers outside the Young Ottoman group to contrast or to show the similarities of their approach with that of the Young Ottomans. Survey of the whole spectrum of Turkish political ideas in the 1860's and 70's was thus achieved.

Upon investigation it was found that the Young Ottoman movement can be explained in the light of two elements which stood in the background of Turkish history up to the beginning of the nineteenth century. One of these was Islamic political theory and the other the Ottoman historical experience including governmental organization and "political behaviour." Of these two basic elements Islamic theory was based on a theocratic conception of the state which indissolubly joined political and religious leadership, gave no place to the private wishes of the individuals in the shaping of the political system and philosophically was devoid of and opposed to a conception of self-moving social or historical processes. Thus by itself there was nothing that made for a rapprochement between Islamic and Western political theory, the latter being based on opposite premises. The opportunities for such a "rapprochement" were provided by other developments. One of these was the process of decline of the Ottoman Empire. To put an end to it Sultans and statesmen at various times endeavored to adopt the ways of the West, first in military affairs and thereafter, when Balkan nationalism began to speed-up the decay of the Empire, in administrative and governmental affairs.

A second force pushing in the direction of Westernization was the rise of a new bureaucratic class created by the Turkish reformers mentioned above. Their abuses created a need for a restraining framework. For the Young Ottomans such a framework was best provided by the principle of responsible government and European parliamentary institutions. Parliamentary government rather than other solutions was adopted by them because certain practices of the Ottoman state had made the idea of popular control of government not entirely alien to the Turks.

Finally the process of disintegration to which the Ottoman Empire was subject and the progressive separating-out of various national groups from the body of the Empire made the Young Ottomans turn inward to a



re-assessment of the role of the Turkish element in the population of the Empire. Thus nationalism was the second operative ideal which established itself in Turkey at this date.

The philosophical implications underlying liberalism which was part and parcel of parliamentarism and constitutionalism in the nineteenth century were at odds with Islamic political philosophy. The attempt that was made by the Young Ottomans to conciliate the conception of responsible government with Islam were therefore full of internal contradictions. It is suggested as a tentative hypothesis--still to be substantiated in a further study--that this internal contradiction was the reason for which at a later date and specially after the creation of the Turkish republic such attempts as conciliating Islam with the Western ideal of government by consent were abandoned for a lay theory of the state.

Microfilm \$4.15; Xerox \$14.00. 323 pages.

### THE RECONCILIATION OF ENERGY AND OBJECTIVES: A STUDY OF THREE CASES IN AMERICAN FOREIGN POLICY

(L. C. Card No. Mic 58-5182)

Hoke LaFollette Smith, Ph.D.  
Emory University, 1958

The problem considered within the dissertation is the result of an attempt to formulate a concept of "national interest" useful in the analysis of international relations. It was decided that the term is often used but is rarely adequately defined. Preliminary research revealed that the term as currently used may have one or more of three basic meanings. Because of this, it was abandoned in favor of national "interests"; that is, the notion that a nation has a multitude of discrete interests which are expressed outside its boundaries.

Each of these interests may be analyzed in terms of its four elements: area, content, energy-method, and ends; a conceptualization which permits the analysis of many problems of international relations. From these possibilities the relationship of energy-method and ends was chosen for detailed analysis. There exist in this area some commonly accepted generalizations concerning the reconciliation of energy and objectives which have never been closely examined. It was thought that a study of these generalizations as tested by practice would serve the dual purpose of validating them and of revealing what usefulness the conceptualization of interest possessed.

The examination took the form of case studies of three recent crisis points in American foreign policy: the Korean crisis of 1950, the Suez crisis of 1956, and the Berlin blockade of 1948. The assumptions of the reconciliation of energy and objectives were examined by the application of the system of analysis to commonly available sources such as the *New York Times*, *The Department of State Bulletin*, and official government and international documents. This was done in order to test the validity of the system when applied to contemporary events.

The case studies demonstrated the usefulness of the analytical system in selecting and analyzing data, and also indicated that the assumptions concerning the recon-

ciliation of energy and objectives were valid. During the Korean crisis, the United States adjusted its energy application to meet the change in the milieu brought about by the North Korean invasion. When the energy applied was seemingly more than sufficient to achieve the existing objective, the objective was revised to utilize the energy more efficiently. In the Suez crisis, the United States voluntarily limited the type of energy which it would apply and as a result was forced to modify its objective to fit its energy application. In the instance of the Berlin blockade, the United States remained adamant in maintaining its objective and so was forced to modify its energy application to deal with changes in the milieu.

Although the analytical system worked well and demonstrated the utility of the four-part conceptualization of interest, the case studies reveal that several of the concepts must be more precisely constructed if the system is to achieve its maximum usefulness. The element which seemed to require the greatest amount of future clarification is that of energy.

Despite the need of increased precision to achieve its maximum usefulness, the analytical system built upon the four-element conceptualization of interest proved to be highly useful in selecting, analyzing, and explaining the data of recent international events.

Microfilm \$3.65; Xerox \$12.20. 280 pages.

### POLITICAL SCIENCE, INTERNATIONAL LAW AND RELATIONS

#### THE UNITED STATES DECISION TO AID SOVIET RUSSIA IN 1941: FOREIGN POLICY AND DOMESTIC POLITICS

(L. C. Card No. Mic 59-46)

Raymond Howard Dawson, Ph.D.  
The University of North Carolina, 1958

Supervisor: S. Shepard Jones

This is a study of the policy of the United States toward the Soviet Union as it developed in consequence of the outbreak of war between Germany and Russia in 1941. It describes the process of policy-making which resulted in the announcement made by President Roosevelt on November 7, 1941, that lend-lease assistance would be supplied to Russia to strengthen its war effort against Germany. Further, the study seeks to relate the decisions about policy toward the Soviet Union to the broader complex of foreign policy problems which confronted United States officials. Finally, it attempts to relate these decisions to the climate of American public opinion within which the decision makers acted.

The major focus of this study of the decision to aid Russia is upon the analysis of the interaction of domestic politics and foreign policy. Its conclusions point to the fact that foreign policy decision-making is inadequately understood if examined in isolation from the domestic situation in which the decisions are partially rooted.

Specifically, the conclusion reached was that the



decision to aid Soviet Russia represented the directing of United States policy along much less controversial lines than the other alternatives open to the President as a result of the German invasion of Russia in June 1941. Despite the heritage of Soviet-American hostility, the domestic political liabilities of a rapprochement with Communist Russia were less dangerous than those implicit in other lines of action left open in the situation created by the German-Soviet war.

American policy in this instance was largely the handiwork of the President, and his actions toward Russia provoked many serious misgivings and occasional opposition within the executive branch. The President formed his policies with great circumspection, attempting to avoid any public debate on the issue of aid to Russia. This was because, initially, there was every indication of intense opposition to such a policy. Isolationists insisted that aid should not be given, and interventionist leaders were generally noncommittal. By the fall of 1941, however, little serious opposition remained. This was symbolized when, in October, the House of Representatives defeated by a vote of eight to one a proposal to exclude Russia from any lend-lease aid.

The explanation for this absence of determined opposition, it was concluded, was fundamentally in the fact that such a program lay within the framework of accepted national policy. This accepted policy was that of "all aid short of war" to the enemies of Germany and its allies, as consolidated in the enactment of the Lend-Lease Bill in March 1941. Lend-lease represented a national consensus as to the wisdom, first, of seeking to promote the defeat of Germany, but, second, striving to keep America out of the war. Aid to Russia fell within the limits of this consensus.

Americans of interventionist beliefs accepted the decision since they regarded Germany as a threat to national security. They distrusted Soviet Russia, but they did not fear Russian power. For them, national interests and military necessity pointed to the wisdom of helping the Russians.

Most isolationists came to see in Russia's continued resistance to Germany powerful support for their contention that no national emergency existed which warranted the abandonment of non-belligerency by the United States. Willing to encourage the maintenance of a front in Russia for this reason, they accordingly made little effort to obstruct the decision to supply American aid.

Thus, the decision to aid Russia was prompted by military necessity and bore the imprint of the President's methods and personality. In a basic sense, however, the decision was a consequence of accepted national objectives, and was in keeping with the prevailing attitude of the American people.

Microfilm \$6.10; Xerox \$21.40. 479 pages.

# THE INTERNATIONAL REGIME ON THE DANUBE RIVER WITH SPECIAL EMPHASIS ON THE POST-WAR PERIOD, 1945-1954

(L. C. Card No. Mic 59-831)

Milos Martić, Ph.D.  
University of Colorado, 1958

Supervisor: Professor Henry W. Ehrmann

The Congress of Vienna of 1815 established that international rivers should be open for the commercial vessels of all nations on an equal footing, but the administration of the rivers should be in the hands of the riparian states. These principles were not applied on the Danube until the Treaty of Paris in 1856 which established the two-commission system.

Although the Treaty of Paris officially recognized the Vienna Congress provisions, it made a notable exception to the principle of riparian control. For the first time in the history of fluvial law, the non-riparians took part in the administration of a particular river. Since that time the history of the international regime on this waterway has consisted of a permanent struggle between the riparians and the non-riparians.

When we analyze the history of Danubian navigation, its legal, economic, and political aspects, two conclusions appear obvious: (a) that the principles of fluvial law could not ensure actual freedom of navigation on this waterway, and (b) that the big powers have tended constantly to use and modify the idea of freedom of navigation to suit their own politics. Many of their methods and means have been quite similar, though far from identical.

In fact, neither the provisions of the Paris Treaty of 1856 nor the rules established by the 1921 Danubian Convention could actually determine the regime on the Danube. Fighting for their own interests, the big powers modified most of those principles in trying to establish such a regime as would guarantee either their political or economic control and influence over the Danube area.

The 1948 Convention provided for free navigation for all flags as well as exclusive riparian control over the river. The new Danubian Convention seemed to be a step forward from the point of view of conventional fluvial law, but actually made it possible for the Soviet Union to modify its essential principles, and later--especially during the period from 1949 to 1953--to achieve complete control over the newly established commission.

Very soon the Russians completely ignored the 1948 Convention, and converted the post-war Danubian Commission into a kind of navigational department of the U.S.S.R. The Secretary--a representative of the U.S.S.R.--was put in charge of carrying out the whole activity of the Commission. He was responsible not to the Commission, but to the Soviet Government. Even in the event of his absence, his duties were to be performed by a deputy from his delegation or by another person chosen by Moscow.

Although the presence of political ideologies has indisputably influenced the character of the Danubian regime, it seems that their importance has been exaggerated. Regardless of ideologies, the big powers acted first of all as powerful nation states and then as representatives of Communism, Fascism, Western Democracy, etc. In the light of their actions and their attempts to modify the



principles of international fluvial law, reasonable doubt could be expressed regarding the general significance of these principles. The international regime on the Danube appears in this respect as an example of the denial of international fluvial law. All in all, politics seem to have killed this waterway, which instead of being a means for further development of international trade and cooperation, has become little more than a permanent subject for international disputes.

Microfilm \$4.65; Xerox \$11.60. 361 pages.

#### JUDICIAL SETTLEMENT OF INTER-AMERICAN LEGAL DISPUTES

(L. C. Card No. Mic 58-2820)

Isidoro Zanotti, Ph.D.  
The American University, 1958

##### The Problem

This dissertation deals with the question of the judicial settlement of legal disputes between two or more American governments through a permanent international judicial institution. What international judicial institution has settled or could settle the legal disputes between governments of the American countries? To answer this question, the following principal topics are discussed: the Central American Court of Justice (1907-1918); the attitude of the American states toward the World Court of Justice, and the cases taken to and decided by the Court in which American states were parties (1920-1957); the proposals made for the creation of an Inter-American Court of Justice and resolutions thereon of inter-American conferences (1923-1954); the American Treaty on Pacific Settlement - the Pact of Bogotá - (1948), whose chapter four recognizes as compulsory *ipso facto* the jurisdiction of the International Court of Justice in legal disputes between American states; and what court of justice functions in the European regional system.

##### Methods

In the research the following materials were used: documents published before, during and after meetings of the Organization of American States; United Nations publications; and books and law journals. In examining this material and writing our dissertation we used the descriptive, analytical and comparative methods. The text is divided into 11 chapters plus a bibliography. Since at the end of 1957 there was no comprehensive treatment of the judicial settlement of inter-American legal disputes, the information gathered and the studies made therein should be useful for those interested in inter-American relations.

##### Conclusions

The first international court of justice was established in the Western Hemisphere. The Central American Court of Justice, created in 1907, served the five Central American countries, and although it functioned for only ten years and dealt with ten cases, it had historical significance.

Between 1949 and 1951, the International Court of Justice dealt with the Colombian-Peruvian Asylum Case, the first and only case in the history of the World Court

(1920-1957) in which a dispute between two American states was brought before and decided by the Court. In other instances, American states were parties in cases involving non-American countries. In 1957, Honduras and Nicaragua agreed to submit a boundary dispute to the Court.

The Inter-American System has never had its own judicial organ, in spite of several proposals to create an Inter-American Court of Justice. At the end of 1957 the prospects for the creation of such a court were not bright. The American countries have, however, made frequent use of pacific procedures other than judicial: good offices, mediation, investigation, conciliation, arbitration, and consultation. As the Inter-American System has evolved, cooperation among the American countries has been strengthened and an effective peace machinery has been created.

The Pact of Bogotá (1948) codified nine earlier inter-American peace instruments. It was the first inter-American multilateral treaty to make the International Court of Justice an instrumental for the judicial settlement of disputes between American states, although all of them have firmly supported that Court because they believe in international law and justice.

A regional court of justice has been established in Europe. The six countries that have bound themselves into three Communities - Coal and Steel (1951) and Economic and Atomic Energy (1957) - have such a court, which has been functioning since 1954.

There is no tribunal to protect human rights functioning yet, although the members of the Council of Europe signed a convention creating one in 1950. At the end of 1957, it seemed unlikely that one proposed for the Americas would be created in the near future.

Microfilm \$3.65; Xerox \$12.40. 281 pages.

#### POLITICAL SCIENCE, PUBLIC ADMINISTRATION

##### ACHIEVING ADMINISTRATIVE INTEGRATION: THE OREGON DEPARTMENT OF FINANCE AND ADMINISTRATION

(L. C. Card No. Mic 58-3941)

Bertram Aggrey Nathaniel Collins, Ph.D.  
University of Oregon, 1958

Adviser: Egbert S. Wengert

This is a study of an effort of administrative integration being made in the state of Oregon. It examines the pre-natal and post-natal history of Oregon's Department of Finance and Administration. By the co-ordination or unification of staff and control units in one central agency, a Department of Finance and Administration tests an hypothesis that fiscal and administrative integration can help to bring efficiency and economy to the operations of state government. This study is concerned with the progress of that experiment under actual conditions of recent political and administrative circumstances in the state of Oregon.



The study covers the period 1949-1955. After introductory sections concerned not with the nuances but the broad outlines of American administrative theory, and of the long course of reorganization in Oregon, the study takes as its starting point the passage of House Joint Resolution 32 by the 1949 Oregon Assembly. This resolution called for the creation of a Legislative Interim Committee to investigate the operations of state government and to make recommendations for their improvement. The Interim Committee published reports on state administration, and proposed legislation which created a Department of Finance and Administration in Oregon. From August, 1951, through December, 1955, this department exercised its authority and discharged its responsibilities in the fulfillment of its objectives as these were generally conceived and pursued by its first director, Harry Dorman, and his staff. The head of the department was responsible to Governor Douglas McKay, and after his resignation at the end of 1952, to Governor Paul Patterson. The study terminates with the retirement of the director, after the new agency was firmly established.

The study states and generally accepts the findings of the Interim Committee on Oregon government in 1949. It examines the political process by which recommendations went from idea to enactment, from the study stage to the legislative stage. It analyses some of the problems involved in creating a new department, the frustrations of attempted innovations, the penalties of change. It selects particular aspects of the department's operations for examination and criticism. In a series of six illustrative episodes, aspects of the department's impact on its administrative and political environment are demonstrated. These case-studies culminate with the critical legislative examination which the department successfully underwent in the 1955 session of the Oregon Assembly.

Gathering of data was a continuous process that began in the summer of 1955 and continued through successive years of employment in the state. Four main methods were employed in preparation for this study: participation in the activities of the department; the study of documentary material; intensive and extensive interviewing; and the compilation of general background knowledge of Oregon and the Pacific Northwest.

The writer participated to some degree in the processes of the Department of Finance and Administration. In the summer of 1955, as an administrative trainee, he was able to have a privileged view into the working of the department's machinery, and to make some contribution to it. Further employment in state government in other agencies permitted the writer to view the department with some detachment, and to learn of its impact on the agencies over which it exercised some control.

The writer was able to obtain access to a great deal of relevant documentary material which had been left unpublished. Some of the material was of a confidential nature, and supplied the writer with useful insights. Other, like the remnants of the working papers of the Legislative Interim Committee on State Government Administration, are largely unclassified, and are available in the State Archives. Documentary material on Oregon state reorganizations was supplemented by the material on recent financial and administrative reorganizations in other states, a good response to a questionnaire sent to states and territories in September, 1956. The author was also able to obtain access to a quantity of memoranda, letters and

bulletins maintained in the files of the Oregon Department of Finance, in the records of the Oregon State Tax Commission and the Oregon State Civil Service Commission.

These records were illumined and supplemented by a program of intensive interviewing conducted not only with the participants mentioned in the study, but with many other state employees and officials, with legislators, and with informed observers of many political complexions. The writer always sought to be aware of the biases in others and in himself; hardly any information received was accepted with unqualified reliance.

A great deal of the background which the author needed was obtained from lengthy perusal of newspapers published during and before this period, and by readings in the history of the Pacific Northwest. To obtain a sharper awareness of recent political circumstances in the state, the author arranged to attend numerous political gatherings, to attend meetings of other Legislative Interim Committees, and of the Board of Control, and to attend sessions of the 1957 Legislature and its committees. The author takes full responsibility for the selection and interpretation of the material and information employed.

The study is concerned with the beginning stage of an experiment and can offer results only of a short-run analysis. Nevertheless, this example of Oregon's administrative experimentation reveals such useful lessons as these: that it is necessary, if they would be successful, for administrative planners to adjust to the prevailing political, ideological, and material circumstances, and even to choose apparently paradoxical means of attaining their goals; that the vagaries of the participants' behavior can considerably reshape the course of an administrative experiment; that the impact of a control agency on its environment results *inter alia* in the modification of the policies and activities of the agency; that if administrative policy is a rational attempt to obtain a desired set of conditions, policy makers are compelled to accept satisfactory results rather than expected results. The Oregon experiment can continue to provide administrative planners in other states and in other places with more 'intelligence' in order that they might anticipate and prepare for circumstances, before policy is overtaken by events. Microfilm \$3.80; Xerox \$12.80. 295 pages.

#### THE TOP MANAGEMENT TRIANGLE IN VOLUNTARY HOSPITALS: AN EXPLORATORY STUDY OF THREE HOSPITALS

(L. C. Card No. Mic 59-1200)

Paul John Gordon, Ph.D.  
Syracuse University, 1958

This study deals with problems of organization within the top management triangle of three voluntary hospitals. In order to guide the general progress of an exploratory study, the following hypotheses were established:

1. There are distinctive problems of organization in the voluntary hospital.
2. There is a relationship between the type of administrative structure and institutional arrangements established in a hospital and the types of problems with which that hospital has to deal.



3. There is a relationship between the hospital size and the techniques of organization employed in the hospital.
4. Hospitals affiliated with teaching institutions afford administrators more alternative ways of dealing with medical staff problems.

The methods employed for this investigation included: preliminary research on voluntary hospitals generally; development of hypotheses and assumptions; selection of organizational concepts and definitions for this study; selection of hospitals for study; and familiarization with these hospitals and their organizations. The methods also included: the construction and use of problem rating scales in order to record the administrator's perceptions of problems in each hospital; the identification of top management triangle problems for subsequent investigation; a second round of interviews with administrators in order to penetrate further the problems and organizational arrangements in each hospital; and case analyses of findings.

In this entire study, heavy reliance was placed on the information and perceptions provided by the hospital administrators. In general, the analytical framework proceeded from the problem situation as perceived by each administrator; to the case illustration of events and behavior as reported by each administrator; to exploration of the use of organization as a means of control in coping with problems in each hospital; to analysis and comparison of the findings among the hospitals in terms of the apparent consequence in each case and in terms of the four major hypotheses.

An exploratory study of this kind, limited to three hospitals, produces results that are more insights than conclusions. These insights, however, insofar as they contribute to increased understanding and further research on the problems of organization in hospitals are important in themselves. With regard to these hospitals, the findings were that:

1. The peculiar legal, functional, economic, political and social position of the doctor in the hospital gives rise to distinctive problems of organization in voluntary hospitals. Organizational problems arising out of the position of the doctor in the hospital were the only problems in these hospitals that have no counterpart in kind in non-medical, non-hospital organizations.
2. There frequently can be demonstrated a direct relationship between the organizational arrangements in a hospital and the types of problems with which that hospital has to deal. In these hospitals, for example, the structure and staffing of the board of trustees and the medical staff were closely associated with the severity of problems as perceived by the administrators.
3. The study revealed no clear relationship between the hospital size and the techniques of organization employed in the hospital at the level of the top management triangle. Such a relationship was more observable at the departmental level of each hospital.
4. The hospital that was affiliated with a teaching institution afforded the administrator more alternative ways of dealing with medical staff problems.

This does not necessarily mean that the administrative task was easier. It simply means that the alternatives were greater in number.

Microfilm \$4.65; Xerox \$15.60. 361 pages.

#### COUNTY GOVERNMENT AND ADMINISTRATION IN ALABAMA

(L. C. Card No. Mic 59-430)

James Dannelly Thomas, Jr., Ph.D.  
The Ohio State University, 1958

The purpose of this study was to determine the organization, powers, and functions of county government in Alabama and to recommend changes deemed necessary or desirable for its improvement. Patterns of county government organization in Alabama were determined, primarily, through the study of appropriate legal materials. These patterns were compared with those generally prevailing in the United States, as described in general works on the subject. Recommendations were made on the basis of an evaluation of suggestions generally made for the improvement of county government and a consequent judgment concerning their suitability and applicability to Alabama conditions.

County government in Alabama differs little in its essentials but greatly in its details from the patterns of county government generally prevalent in the United States. Two of the severest problems confronting county government in the United States are (1) the existence of small, sparsely populated counties which are too poor to provide effective and efficient government; and (2) certain structural defects in county governmental organization. These problems were found to be especially severe with respect to county government in Alabama.

Counties in Alabama differ widely in area, population, and taxable resources. Many Alabama counties fail to measure up to reasonable standards of wealth and population necessary to perform adequately the functions assigned to them. County government in Alabama, as in other states, is characterized by extreme disintegration and lack of coordination. Responsibility for the performance of county functions is not concentrated in the hands of the county governing body, and the governing body shares responsibility with a number of elective officials and special boards, commissions, corporations, and authorities.

Various proposals for improving the organization and operations of county government were studied and evaluated. It was suggested that the problem of county fiscal inadequacy could be met, that the need for administrative unification could be achieved, and that vital, responsible, and efficient county government could be secured for the state, through the adoption of a program of reconstruction involving (1) county consolidation; (2) the establishment of a sound plan of state fiscal aid, under which equalization grants are allotted in accordance with the need of each county; (3) amendment of the constitution to permit the people of each county to adopt, after an election on the question, one of several optional forms of county executive government; and (4) adoption of an effective method by which to curtail the enactment of excessive local legislation. Microfilm \$5.90; Xerox \$20.60. 463 pages.



## PSYCHOLOGY

### PSYCHOLOGY, GENERAL

#### NISEI PERSONALITY CHARACTERISTICS AS MEASURED BY THE EDWARDS PERSONAL PREFERENCE SCHEDULE AND MINNESOTA MULTIPHASIC PERSONALITY INVENTORY

(L. C. Card No. Mic 58-7942)

Steven Kiyoshi Abe, Ph.D.  
University of Utah, 1958

The purpose of this study was an objective assessment of Nisei personality characteristics as measured by the Edwards Personal Preference Schedule (PPS) and the Minnesota Multiphasic Personality Inventory (MMPI). It was hypothesized that because of bicultural influences the Nisei will differ from the PPS and MMPI normative samples.

A total of 207 adult Nisei men and women from several western states were administered the PPS and MMPI. Of this total, 104 men and 103 women completed the PPS, while 102 men and 100 women completed the MMPI.

On the PPS there were significant differences on 10 out of 15 variables in each of the following comparisons: (1) Nisei men with Nisei women, (2) Nisei men with Normative men, (3) Nisei women with Normative women, and (4) total Nisei sample with total Normative sample.

On the MMPI, including the with and without K scales, Nisei men and women differed significantly on 8 out of 20 scales. Eliminating the without K scales, Nisei men differed significantly from Normative men on 14 out of 15 scales. Nisei women were significantly different from Normative women on 10 out of 15 scales.

On the PPS and MMPI there was no significant difference between Nisei born and raised in California from their like sex who were born and raised in Utah. A comparison between the total samples also showed no significant differences.

On the PPS, therefore, Nisei men and women when compared with their like sex in the Normative sample were more withdrawn, possess stronger feelings of inferiority and inadequacy and show greater respect for authority. Also, they were more rigid and orderly in behavior and were oriented toward persistency and a willingness to help others. They were conversely less dominating and exhibitionistic, and were not prone to studying their own motives or the motives of others. In addition, Nisei men when compared with the Normative men are less oriented toward achievement striving and give less emphasis to asserting their individuality and being unconventional. Nisei women when compared to Normative women give less weight to becoming emotionally involved with others and are less interested in any form of heterosexual relationships.

On the MMPI Nisei men and women have a more elevated profile in general, with the Nisei men showing more significant differences from their like sex in the Normative sample than did the Nisei women from their like sex.

The results suggest that Nisei men and women show more emotional disturbance when compared with the Normative sample. However, this should be substantiated by further investigation.

The overall results suggest that cultural variables have been a dominant factor in the personality development of Nisei. As a result they tend to have a closer identification with each other than with their respective sexual counterparts in the Normative samples. The significant differences obtained from this study were discussed in the light of cultural influences. The number of these differences makes it inadvisable to interpret Nisei test scores on the basis of the existing norms. Therefore, separate norms were established for Nisei men and women on the PPS and MMPI.

Microfilm \$2.00; Xerox \$5.00. 100 pages.

#### AN EMPIRICAL INVESTIGATION OF SEVERAL METHODS OF SCALING ACHIEVEMENT TESTS BASED ON THE INTER-RELATIONSHIPS OF THE TEST ITEMS

(Publication No. 24,127)

Harold F. Bligh, Ph.D.  
Syracuse University, 1957

Achievement test constructors are being asked to provide measures which accurately describe individuals. Two problems are basic: the purposes underlying the testing, and the kinds of information needed to satisfy these purposes. Systems of scores have been developed to provide such information. Interpretations of the scores have usually been in terms of a reference population. The traditional approach has been to set up norms to give meaning to the scores. Attention is being focused on the "adequacy" of current methods of scaling. Test theorists are emphasizing the value of investigating a test's consistency as a preliminary to the application of scaling techniques.

This investigation concerns problems of achievement test construction based on the consistency of item responses. Three tests, Paragraph Meaning, Study Skills and Arithmetic Computation chosen from the Stanford Achievement Battery Adv. Form J, were tested for homogeneity and for unidimensionality as defined by Loevinger and Guttman. Data were obtained from 300 answer sheets of a random sample of eighth grade boys used in the standardization of the Stanford Achievement Battery. A cross-validation sample of 200 cases was drawn from the same population. Green's technique for scale analysis using summary statistics was applied to obtain coefficients of reproducibility, coefficients of chance reproducibility and coefficients of consistency. Results did not warrant the acceptance of the tests as homogeneous or unidimensional scales.

An attempt was made to refine the original sets of



items into statistically homogeneous tests by a technique developed by Du Bois, et al. for the construction of homogeneous keys for a biographical inventory. The resulting tests were so constructed as to maximize the saturation coefficients defined as the ratios of the sums of all the covariances to the variances of the tests. The saturations ranged from .603 to .868 for the initial sample and from .612 to .868 for the cross-validation sample.

The refined tests were tested for homogeneity and unidimensionality with both samples. Indices of homogeneity and scalability did not reach the lower limits arbitrarily set for the acceptance of a test as a homogeneous scale.

Consideration was given to the interpretation of the measures of homogeneity and unidimensionality. Standards for accepting a test as homogeneous on the basis of Loevinger's coefficient are not yet available. Results suggest that a value of .26 might be expected for achievement tests of the nature used in the present study. Theoretical consideration and empirical evidence offer little support for continued use of the coefficient of homogeneity. Standards for accepting or rejecting tests on this basis appear quite different from those for coefficients of reliability.

Green's technique offers advantages as it is objective and relatively simple to compute for large numbers of items and large groups of respondents.

The Index of Consistency developed by Green as a measure of homogeneity produced results comparable in magnitude and range to those obtained with Loevinger's technique.

The relative gain in reproducibility defined as the ratio of the absolute gain in reproducibility to the maximum possible gain in reproducibility offers possibilities for the interpretation of tests which fail to satisfy Guttman's criterion of .90 for the coefficient of reproducibility.

Although the coefficients of reproducibility did not reach the desired lower limit of .90 they clustered around the value of .84 and ranged from .818 to .872. The magnitudes and stability of the coefficients suggest the value of further investigation of the scalability of achievement traits.

The technique for the construction of homogeneous tests by selecting items which maximize the discriminating power of the tests offers possibilities for the construction of achievement tests which measure unidimensional traits. Further investigation is needed to determine the extent to which homogeneous keys aid in prediction.

Microfilm \$2.05; Xerox \$7.40. 156 pages. Mic 58-5231.

#### PREDICTING VOTES OF SENATORS OF THE 83d CONGRESS: A COMPARISON OF SIMILARITY ANALYSIS AND FACTOR ANALYSIS

(L. C. Card No. Mic 59-508)

David James Fitch, Ph.D.  
University of Illinois, 1958

A method of similarity analysis and a method of factor analysis were objectively compared by using each to classify senators of the 83d Senate and to predict voting. One-half or 128 of the nonunanimous roll call votes were used to classify the 88 senators who survived the 83d Senate. Predictions were made for the other 128 votes.

The similarity analysis procedure involved grouping senators together who had similar patterns of voting. The process of combining similar senators and senator groups was continued until eight groups remained. Eight key individuals were picked by selecting the senator in each group who was most typical of his group. The prediction was that members of each group would vote on the second group of issues the same as their key senator.

In the factor analysis procedure eight key senators were picked who accounted for a near-maximum amount of senator variance on the first sample of votes. This was accomplished by (a) correlating senators on these votes, (b) centroid factor analyzing these correlations between people, (c) rotating the first eight factors using the quartimax method, and (d) selecting the senator with the highest loading on each factor. Senators were then classified using the square root method of factor analysis, pivoting on the eight key senators.

The second sample of votes was classified by (a) correlating the key senators on these votes, (b) calculating a square root factor analysis comparable to the first by pivoting on the same senators in the same order, and (c) multiplying the inverse of this factor matrix times the 8 X 128 matrix of senators times votes in unitary standard measure form. The resulting matrix was one of factor scores of votes on factors.

The matrix classifying the second sample of votes was multiplied by the square root senator classification matrix which resulted in a matrix of predictions. These scores, in unitary standard measure form, were transformed into yes-no predictions making use of a neutral cutting point calculated for each senator from his voting on the first sample.

The similarity analysis method correctly predicted for the average senator 92.3 votes or 72.1 per cent of the 128 total. This compared with 99.6 or 77.8 per cent for the factor analysis method. This difference was significant well beyond the .01 level. In a refinement of the similarity analysis method, when a key senator was absent the voting key senator most similar to the one absent was used as the predictor. This raised correct predictions to 97.2 or 75.9 per cent. A t test based on matched pairs showed the difference which still remained in favor of the factor analysis method to be significant at the .01 level.

The similarity analysis classification and the rotated factor analysis were compared subjectively. Each was found to be quite reasonable. The similarity analysis was more readily comprehensible, but this might be considered as due to an oversimplification of a situation which could be better represented by the complexities of a multiple classification system such as factor analysis.

Appendices contained (a) the ILLIAC program written for the similarity analysis, (b) an identification of the votes, (c) the voting of the 88 senators on each group of 128 roll call votes, (d) the votes predicted by each method, and (e) certain of the intermediate results.

Microfilm \$2.95; Xerox \$10.20. 228 pages.



# COGNITIVE CORRELATES OF RESPONSE STYLE

(L. C. Card No. Mic 59-509)

Garlie Albert Forehand, Jr., Ph.D.  
University of Illinois, 1958

Demonstrations of the reliability of response sets have recently drawn attention to the biasing effects of these tendencies and also to their potentiality as sources of information about personality characteristics.

In an attempt to clarify the personality correlates associated with response sets, three hypotheses of relationship between response sets and cognitive variables were formulated. The hypotheses are: (a) the response set of acquiescence to highly general statements will be associated with the cognitive variable of equivalence range, which is defined by the breadth of experiences which one is willing to classify under a single conceptual rubric; (b) extreme response preference in items eliciting affective reactions to stimuli will be associated with equivalence range; and (c) perseverative response set or lack of deviation from one's own modal response choice, in tests of ambiguous or difficult content will be associated with field articulation, defined by the ability or willingness to respond analytically to incongruous perceptual fields.

In an investigation designed to test these hypotheses and to study the generality of the cognitive variables, equivalence range was measured by means of an object-sorting task, judgments on the equivalence of phrases and estimations of the proportions of persons or things having a stated characteristic. Field articulation was measured by means of the degree to which color recognition was hampered by the presence of incongruous color names, ability to detect embedded figures, and ability to reconstruct a verbal sequence which was distorted by misplacement of spaces. Each of the response sets considered was measured in several tests. The variables were administered to 96 subjects.

The variables purportedly measuring cognitive variables did not cluster together empirically as had been anticipated. The intercorrelations of the three equivalence range measures ranged from  $-.09$  to  $.14$ ; none of them were significantly different from zero at the  $.05$  level. The intercorrelations of the three field articulation measures ranged from  $-.06$  to  $.35$ ; although two of the three correlation coefficients were significantly different from zero at the  $.05$  level, the magnitude of the relationship is too small for the variables to be considered measures of a single construct.

None of the three major hypotheses was confirmed, although the response set measures were, in general, reliable. The correlation coefficients expressing relationship between acquiescence to generalizations and equivalence range measures ranged from  $-.09$  to  $.18$ . The correlations between extreme response preference and equivalence range measures ranged from  $-.08$  to  $.25$ . The correlations between perseveration set scores and field articulation measures, which were predicted to be negative, ranged from  $-.20$  to  $.05$ .

These results suggest, first, that the concepts of field articulation and equivalence range are not as general as has been suggested. The failure of measures which are logically consistent with definitions of these variables to covary substantially calls into question their treatment as unitary "system principles".

The results concerning response sets are consistent with growing evidence that response sets are not related to meaningful personality characteristics. The hypotheses of this study were based on the notion that a response set is a manifestation of a general cognitive tendency which would also be reflected in the other cognitive variables. The failure of these hypotheses to be upheld might reflect faulty recognition of elements common to the various tasks. The paucity of demonstrable relationships, however, suggests that cognitive correlates of response sets will be difficult to find. It would appear that the most reasonable conclusion to be drawn from this and previous research is that although response sets are reliable, there is little evidence that they are related to other variables.

Microfilm \$2.00; Xerox \$7.00. 147 pages.

# ACQUIESCENCE AS A FACTOR IN TEST-TAKING BEHAVIOR AND AS A PERSONALITY CHARACTERISTIC

(L. C. Card No. Mic 59-525)

Theodore Robert Husek, Ph.D.  
University of Illinois, 1958

It has long been recognized that people bring to the testing situation certain test-taking habits which influence their scores. This thesis investigated one of these test-taking habits, acquiescence, and tried to develop a "pure" measure of the trait.

The subjects in the study were 231 high school students, 121 females and 110 males. Eight tests were administered to the subjects. They were: a 120 item ESP acquiescence test in which the subjects thought they were reading the mind of the experimenter and answering questions he was purported thinking about (split-half reliability =  $.87$ ; test-retest =  $.75$ ); a 50 item multiple choice vocabulary test (corrected split-half reliability =  $.96$ ); a 100 item yes-no vocabulary test of similar difficulty (corrected split-half reliability =  $.94$ ); the Bass social acquiescence test (corrected split-half reliability =  $.84$ ); the Edwards social desirability scale (corrected odd-even reliability =  $.79$ ); a set of rating scales which the subjects used to rate their classmates (average corrected split-half reliability =  $.65$ ); the same rating scales for the students to rate themselves (average test-retest reliability =  $.46$ ); and the same rating scales for the subjects to rate the experimenter. The rating scales were 7 point bipolar rating scales. The positive ends of the scales were: "initiative;" "sociable;" "intelligent;" "cooperative;" "strong willed;" "independent minded;" "likes to help others;" "good student;" "leader."

There were small correlations among the various measures of acquiescence (none above  $.24$ ). Acquiescence did not relate to the other measures. Its correlations with the ratings given to the subjects were trivial; it was not related to the sex of the subjects; and its correlation with vocabulary was evident only if the coefficient was carried out to three decimal places.

In view of the negative results of this study and the more positive results obtained by other workers with more specific material, it was suggested that acquiescence may not be a meaningful general concept. Perhaps it must be examined with reference to some specific material in



order to give the subjects something to which they may acquiesce.

The Edwards social desirability scale was found to relate to the ratings and to the scores on the vocabulary tests. People who tend to check socially desirable items also obtain better scores on vocabulary tests, and rate themselves and are rated by others as possessing traits related to intelligence.

Microfilm \$2.00; Xerox \$3.80. 70 pages.

#### THE FORM AND THE IMAGINATIVE CONTENT OF CHILDREN'S BLOCK BUILDINGS

(L. C. Card No. Mic 59-1295)

Eleanor Louise Robinson, Ph.D.  
University of Minnesota, 1958

Adviser: Dale B. Harris

The three purposes of this research were: (1) to indicate the range of block building performance which is characteristic of children between the ages of three and ten; (2) to develop methods for ordering block building data so that comparisons can be made; (3) to determine what differences in block building performance may be related to differences in age, sex and intelligence level.

The sample consisted of 5 boys and 5 girls at each of two levels of intelligence (IQ 100-115 and IQ 135-160), in four age groups--three, five, seven and ten. Each of the 80 subjects built three free-choice buildings and one prescribed construction (a castle) with a supply of 300 blocks in ten standard shapes. Photographs of the constructions, a number of measurements and block counts, and protocols, including verbatim accounts of the children's comments, provided the material for study. The analyses included (1) comparisons among subgroups of children on the quantitative and qualitative aspects of block building, and (2) classification of the verbal content of the protocols.

The quantitative analysis shows that as children grow older they tend to use more blocks, to build for longer periods of time, and to build larger and taller constructions. Boys exceed girls in the time spent and in the height of constructions. At every age the variance among children on these quantitative measures is large.

A classification of block constructions according to structural type revealed several age trends. Younger children build simple structural types such as piles and serial arrangements; older children no longer build these. Enclosures appear very early, and children throughout the age range continue to build them. Roofed buildings predominate in the constructions of 5-year olds. Combinations of roofed buildings and enclosures are popular at seven and ten. Boys more often embellish their constructions with towers and use enclosures as accessories. Girls more often build simple enclosures, particularly floor plans and furniture.

Five-point descriptive rating scales of such qualitative features as compactness, verticality, balance, and form level were delineated verbally and by photographic examples. The ratings of judges working independently correlated from .78 to .88. Application of the scales to the third-day constructions of 80 children revealed no

differences related to sex or intelligence. Older children built more symmetrical or balanced buildings.

A 10-point quality scale for the castle constructions, developed by the method of equal appearing intervals, was used to rate the castles of the children in this study. The mean quality ratings increased for successive age groups, and at each age the range of the ratings indicated that the scale could be useful for comparisons of children within an age group.

Analysis of the verbal content of the protocols showed that children use blocks to represent an ever-increasing range of ideas. Younger children most often build a house or a bridge, and seldom add many details. The 7- and 10-year olds often build public buildings and describe their constructions in vivid detail, frequently placing them in geographical or historical perspective. Children at all ages describe their buildings as settings for imaginary activity.

Because blocks stimulate the expression of imaginative ideas and appear to be interesting to most children throughout a wide age range, this study lends support to the statement of many educators that blocks are valuable play material for children.

Microfilm \$3.30; Xerox \$11.20. 255 pages.

#### THE DEVELOPMENT OF A FORCED-CHOICE INVENTORY FOR EVALUATING THE ADMINISTRATIVE ORIENTATION OF INDUSTRIAL SUPERVISORS

(L. C. Card No. Mic 59-648)

Leonard Wollack, Ph.D.  
Temple University, 1958

This study represents an attempt to investigate the importance of the administrative skills of the industrial supervisor. The basic hypothesis was that a supervisor's orientation toward specific administrative skills is to a large extent related to his success as a supervisor. Thus, the major phases of this study were that of constructing and validating an instrument that would measure the emphasis that a supervisor places on various administrative skills. It was decided that a forced-choice format would best serve this purpose.

The population consisted of supervisors employed in two large industrial plants. Items for a forced-choice scale were obtained through the use of a sentence-completion blank and a critical incident questionnaire. Both methods proved effective in terms of item yield and administration time. After modification and revision of the items, three forms of the Preliminary Supervisory Inventory were constructed and administered for the purpose of obtaining item preference and discrimination indices. The mean scale value assigned an item by the supervisors became its preference index. The discrimination index was obtained by having half of the supervisors indicate whether or not the "worst" supervisor they knew did or did not do the things listed on the inventories, and the other half, on the basis of the "best" supervisor they knew. The responses of the two groups were then compared, and the resulting chi square values represented the discrimination indices. Several screenings and classifications of



the items according to content were undertaken by the investigator and several other psychologists. From the analyses of the items, four administrative areas emerged and were designated as follows: (1) "Training", (2) "Work Rules", (3) "Planning", and (4) "Personnel Duties". There were a sufficient number of discriminating items (.01 level), and non-discriminating items with the proper preference values in each of the four areas for the construction of two forced-choice inventories differing in format. The tetrads of Form P contain both discriminating and non-discriminating items, while those of Form D contain only discriminating items.

In the construction of the final Administrative Orientation Inventory Forms P and D, systematic procedures were developed combining items into tetrads, for arranging the items within each tetrad, and for the placing of the tetrads; and in Form P, in addition to the above, the pairing of discriminating and non-discriminating items. Each form of the final Administrative Orientation Inventory contains twenty tetrads. The respondent is requested to select from each tetrad the two items that are "most like" the things he does.

Forms P and D of the final Administrative Orientation Inventory were validated by using data obtained on a new group of supervisors on whom ratings had been made jointly by two plant psychologists. Ratings in the area of Training, Work Rules, Planning, and Personnel Duties, a total rating of administrative skills, and a rating of overall supervisory effectiveness were obtained.

Within the limitations of this study, the following conclusions may be drawn regarding the specific problems investigated:

1. The forced-choice technique can be successfully applied to the measurement of supervisory orientation toward the four basic administrative skills identified by this study: (a) "Training", (b) "Work Rules", (c) "Planning", and (d) "Personnel Duties". The basic hypothesis that a relationship exists between the emphasis placed on administrative skills and success as a supervisor appears to have been substantiated.
2. The results obtained in this investigation indicate that the Administrative Orientation Inventory might be useful in:
  - a. diagnosing an individual supervisor's orientation toward administrative skills.
  - b. evaluating supervisory performance in the different administrative aspects of supervision.
  - c. determining training needs in the administrative aspects of supervision.
  - d. selecting supervisory personnel in industry.

Microfilm \$2.00; Xerox \$6.80. 141 pages.

## PSYCHOLOGY, CLINICAL

### PERSONALITY PATTERNS OF ADOLESCENT DELINQUENT ENURETICS: A COMPARATIVE ANALYSIS BETWEEN ADOLESCENT DELINQUENTS WHO ARE KNOWN TO BE ENURETIC AND ADOLESCENT DELINQUENTS WHO ARE KNOWN NOT TO BE ENURETIC

(L. C. Card No. Mic 58-7613)

Abraham Amchin, Ph.D.  
New York University, 1958

Chairman: Professor Edward Kemp

#### Statement of the Problem

The purpose of the study was to investigate the relationship between enuresis and the personality organization of male adolescent delinquents, in order to elicit specific personality factors which may be found in their character structure.

#### Significance of the Problem

Although investigations of enuresis have been concerned with associated psychological factors, reports are limited within the adolescent level, particularly with delinquents. Yet, a high percentage of delinquents are enuretic.

Of the two major theories concerning the relationship between enuresis and personality structure, one suggests association with psychopathic behavior and delinquency; the other indicates association with neurotic factors.

This theoretical discrepancy indicated that an attempt at clarification was required. Diagnostic, therapeutic, and administrative activities would be aided with greater clarity.

This investigation did not seek to answer all problems concerning enuresis, but to clarify and contribute information concerning specific factors related to the theories presented.

#### The Method and Results

The study compared 32 enuretic with 189 non-enuretic boys in specific areas. In order to evaluate the hypotheses under consideration, data relative to everyday behavior and data concerning psychosexual development of the subjects were obtained.

The Guess Who Test was utilized to obtain behavioral information. Members of specified testing groups identified the person or persons best fitting a particular "Guess Who" statement. The frequency of choice of enuretics and non-enuretics for certain of these statements was evaluated.

The Blacky Pictures Test was utilized to obtain information concerning psychosexual development. In this test, various stages of psychosexual development or types of object relationships within that development were investigated. Responses of enuretics and non-enuretics were compared.

The Case Histories were reviewed to evaluate the variables of chronological age, intelligence, ethnic affiliation, and religious identification. In each of these instances no significant difference between enuretics and non-enuretics was observed.



### Conclusions

It was concluded that the following hypotheses had been supported:

I(a) The enuretic tends to display characteristics which are more passive in manner, than the non-enuretic.

I(c) The enuretic tends to display greater oversensitivity, in terms of fears of rejection by others, than the non-enuretic.

I(d) The enuretic tends to display greater obedience to demands of authority, than the non-enuretic.

II(a) The enuretic tends to have a greater desire for retention of infantile care than the non-enuretic.

II(c) The enuretic tends to display greater fear of women (with castration anxiety), than the non-enuretic.

The following had not been supported:

I(b) The enuretic tends to display greater conscientiousness, in terms of satisfying self-demands, than the non-enuretic.

II(b) The enuretic tends to have greater repressed hostility (with sadistic components), than the non-enuretic.

The following had not been fully supported, but tended in the direction of confirmation:

II(d) The enuretic tends to display greater difficulty in male sexual identification, than the non-enuretic.

### Recommendations

The "neurotic" personality structure of enuretics was a basic generalization of the study. Acceptance of enuresis as representing this structure would suggest greater sympathy and definition in treatment with a psycho-therapeutic approach being implied.

Future research could compare delinquent and non-delinquent adolescent enuretics, to evaluate suggested similarities. Of interest would be a study of females and an evaluation of degree of disturbance with frequency of enuretic occurrence. Finally, research in therapy techniques would be of ultimate importance.

Continued investigation could offer greater clarity in understanding the relationship between a physical symptom such as enuresis and its psychological cause. With this knowledge prevention of such symptoms would be more greatly assured.

Microfilm \$2.00; Xerox \$7.00. 149 pages.

### PSYCHOLOGICAL CHARACTERISTICS OF ADOLESCENTS IN A KINDRED KNOWN TO HAVE FACIO-SCAPULO-HUMERAL MUSCULAR DYSTROPHY

(L. C. Card No. Mic 58-7608)

Geraldine Elizabeth Bryan, Ph.D.  
University of Utah, 1958

Chairman: Moroni H. Brown

The present study is an investigation of the psychological characteristics of the adolescents in families in a single kindred in which one parent is known to have facio-scapulo-humeral progressive muscular dystrophy. Thirteen dystrophic and 11 nondystrophic subjects from 11 families in 3 communities (2 rural and 1 urban) were used. The diagnosis of muscular dystrophy was established by a medical examination.

A battery of psychological tests was used which included the Wechsler-Bellevue Intelligence Scale, (Form I), the Bender Visual Motor Gestalt Test, Figure Drawing, Gray's Oral Reading Paragraphs Test, and four plates (1, 2, 3 BM, and 17 BM) from the Thematic Apperception Test. In addition, interview and observational data were collected from the subjects and from their parents. The test, interview, and observational data on the subjects were evaluated according to 15 categories of intellectual and personality characteristics.

Comparisons were made between dystrophic and non-dystrophic subjects in regard to their relative standing on each of the 15 categories. Comparisons were also made between the subjects (irrespective of their diagnoses) living in the parent community and the subjects living in each of the other two communities.

The results of these comparisons in regard to intellectual functioning are as follows:

1. The 24 subjects were intellectually superior to the general population. The range of Wechsler-Bellevue Full Scale IQ's was from 92 to 138, inclusive, and the mean of the group was 114.

2. Nondystrophics generally achieved higher scores on the intelligence test. However, the individual variability was high.

3. The differences between the obtained IQ and the AQ (Altitude Quotient -- based upon the IQ equivalent of the prorated average of the top two weighted subtest scores) generally were greater for nondystrophics, suggesting that nondystrophics not only functioned at a somewhat higher intellectual level but also that they did so without utilizing their abilities as fully as did the lower scoring dystrophics.

4. The dystrophics tended to have higher academic-intellectual interests and fewer of them received low ratings on reading achievement.

5. The subjects living in the parent community functioned, as a group, at a lower intellectual level than did those from either the urban or the other rural community.

6. High academic-intellectual interests and high reading achievement ratings were more common among the subjects from the urban community.

The results of the comparison among the subjects in regard to personality characteristics are as follows:

1. The dystrophic subjects tended to be more reality bound in their attitudes toward the future while the non-dystrophics were more optimistic.

2. There was a tendency for nondystrophics to make figure drawings that were expansive in size and that had more reworking and sketching than did those of dystrophics. The differences in figure drawings between the two groups were so few that either the self-concept and body image was not projected by these subjects in these drawings, or, if it was projected, there was virtually no difference between the two groups in the way in which they regarded themselves.

3. Subjects from the urban community were more optimistic in their attitudes toward the future than were those from either of the rural communities.

4. As a group and irrespective of their diagnosis or community background, the subjects were stable. The reactions of both parents and subjects differed from those expected on the basis of previously reported information. There were no indications of undue anxiety, guilt, depression, or aggressiveness; or of overconcern about dystrophy, physical status and changes; or of pressure for treatment and cures.



The following incidental observations were pertinent to the characteristic attitudes of the subjects and their parents:

1. More negative attitudes in the community were reported by the parents in Paradox Valley. This was less marked in the other rural community, and negative attitudes on the part of the community were not inferred at all by parents from the urban community.

2. As a group, the nondystrophic parents took more interest in the potential problems associated with muscular dystrophy, took the initiative in arranging appointments for their children, and were more talkative about the familial incidence of the condition.

On the basis of these results, it can be concluded that the subjects as a group were intellectually above average and of remarkably good mental health.

The information obtained from the present study of adolescents and their parents in one kindred was not intended to be used as a basis upon which inferences are to be made regarding other dystrophic individuals. However, this study suggests that the personal value system may be significant in determining psychological reactions of parents and the attitudes which they pass on to their children. This value system may be derived from any number of sources including religious, cultural, or specific community influences.

Microfilm \$2.45; Xerox \$8.60. 188 pages.

#### THE EFFECT OF AFFECTIVITY UPON DISCRIMINATIVE JUDGMENT IN SCHIZOPHRENICS AND NORMALS

(L. C. Card No. Mic 59-204)

Nick J. Colarelli, Ph.D.  
Northwestern University, 1958

Supervisor: Janet A. Taylor, Ph.D.

Previous research has indicated that the intellectual performance of schizophrenic Ss is adversely affected, at least in part, by the affective context attending any given intellectual task. The present study was designed to investigate this effect. Ss were presented tachistoscopically with a series of plates. Each plate consisted of two pairs of pictures, the members of the pairs being placed under one another and the two pairs being placed side by side. In one-third of the plates the members of the pair to S's right were always different. In a second third the members of the pair to S's left were different, and for the final third there were no intrapair differences, i.e., both pairs were the same. Two groups of plates were presented: one consisting of 12 plates portraying non-affective scenes of impersonal objects; the other of 36 plates portraying affective scenes involving mother-child, father-child, self-concept, and self-environmental relationships. For each of the affective plates, one of the pairs was always a pleasant scene, the other an unpleasant scene. S's task was to identify those pairs which were different, or to indicate that both pairs were the same.

The plates were presented to a control group of 20 hospitalized normal VA orthopedic patients and to an experimental group of 20 hospitalized acutely schizophrenic

VA patients. Differences of only minimal or borderline significance were found. Schizophrenics did make more errors overall than normals and demonstrated greater variability of response with respect to errors on those plates where both pairs were the same. Normals were found to be more variable on those plates where the unpleasant pair was different. Consistent but nonsignificant trends indicated that schizophrenics made more errors on the unpleasant stimuli and tended in general to avoid these stimuli more so than normals.

The results were interpreted as offering little or only borderline support to the hypothesis that affective factors interfere with the judgmental performance of schizophrenics. However, in view of the trends and the possibility of sampling bias entering into the selection of Ss, continued research in this area was felt to be warranted.

Microfilm \$2.00; Xerox \$4.00. 74 pages.

#### SELF THEORY AND CHLORPROMAZINE TREATMENT

(L. C. Card No. Mic 58-7588)

Clyde S. Congdon, Ph.D.  
Vanderbilt University, 1958

Supervisor: Professor Theodore Landsman

The purpose of the present investigation was to study the self-concept, the ideal self, and the generalized other of chronic schizophrenics and to note the changes in these concepts as a result of chlorpromazine treatment.

In carrying out this objective, three groups with twenty subjects each were matched on age and sex. One group consisted of hospital attendants and the other two were composed of chronic schizophrenics (additionally matched on diagnosis). The scales for measuring self, ideal, and generalized other were all modifications of the Tennessee Department of Mental Health Self-Concept Scale. In addition, the Hospital Adjustment Scale was completed for each schizophrenic. At the end of the pretesting period, one of the schizophrenic groups was placed on chlorpromazine treatment, while the other was placed on a placebo. The duration of treatment was two months and, at the end of this time, all of the scales were readministered to the three groups.

It was hypothesized that the schizophrenics would be extremely deviant (extremely high and extremely low in comparison to the normal group) on the self-concept and generalized other scales and that this extremeness would be significantly reduced in the group receiving chlorpromazine (indicating a normalizing trend). No hypotheses were made concerning the ideal self, but it was presumed that it would differ little from group to group and that it would remain unchanged by chlorpromazine. The groups were compared with each other two at a time through the use of nonparametric statistics. Extremeness of score was defined in terms of absolute deviation from the mean of all scores used in that particular comparison. Raw scores as well as deviation scores were examined.

On the self-concept pretest, the two schizophrenic groups had significantly larger deviation scores than the normal group. Although the schizophrenics tended to



score at the extremes, the majority of cases fell at the negative end of the distribution. As a result, both psychotic groups had significantly lower self-concept raw scores than the normal group.

Distortion of the self-concept, as measured by the L Scale on the TDMH Self-Concept Scale, was not significantly greater in the schizophrenic groups than in the normal group.

On the ideal scale, the deviation scores were larger in the psychotic groups than in the normal group, but only the normal group and the chlorpromazine group were significantly different on the pretest. The raw score data revealed that both schizophrenic groups had significantly lower (more negative) ideal scores than the normal group ( $p < .01$ ).

At the end of the treatment period, the same relationships that existed between the groups on the pretest generally prevailed on the posttest. The chlorpromazine group showed no significant changes from pretest to posttest on the self, ideal, or generalized other sorts. This applies to the raw scores as well as the deviation scores. On the behavioral rating scale, however, the chlorpromazine group showed a significant improvement in adjustment. The areas showing significant change concerned communication, interpersonal relationships, and care of self. No significant changes were found in the placebo group.

The main conclusions of the study were:

1. In comparison to normal individuals, schizophrenics tend to have self-concepts which are highly positive or highly negative, although the preponderance of them fall on the negative side.
2. The schizophrenic's ideal is significantly lower (more negative) than the ideal held by normal individuals.
3. The discrepancy between the self and ideal varies greatly in schizophrenics, but tends to be smaller than in normal persons.
4. The schizophrenic's concept of the generalized other is more extreme (more positive or more negative) than is the normal person's.
5. Chlorpromazine treatment produces an improvement in behavior, particularly in the areas of communication, interpersonal relationships, and care of self.
6. Chlorpromazine treatment produces no significant changes in the self-concept, the ideal self, or in the generalized other.

Microfilm \$2.05; Xerox \$7.20. 155 pages.

# SEMANTIC CORRELATES OF INTERPERSONAL CONCEPTS AND PARENTAL ATTRIBUTES IN SCHIZOPHRENIA

(L. C. Card No. Mic 59-995)

Roland S. Engelhart, Ph.D.  
Duke University, 1959

Supervisor: Dr. Norman Garmezy

The present experiment attempted to investigate the semantic correlates of classes of interpersonal and parent-child relationships which have been found to be associated with deficits in the experimental performance of schizophrenic patients. It was also hoped to obtain infor-

mation concerning the familial backgrounds and relationships of such patients. The particular procedure employed was the Semantic Differential.

Three major groups of normal and good and poor pre-morbid schizophrenic Ss were employed. The Phillips Scale of Premorbid Adjustment was used in dividing the schizophrenic group. Since a large number of the schizophrenic Ss were receiving tranquilizing drugs, the experimental results were analyzed for five separate groups: Non-Drug Goods, Drug Goods, Non-Drug Poores, Drug Poores and Normals.

A series of trait-names was selected to represent several categories of interpersonal and parental behavior of presumed significance to schizophrenic patients. These categories were the following: Affection, Overprotection, Domination, Punitiveness, and Strictness. These traits were paired with a group of Semantic Differential scales representing the three major dimensions of meaning (Evaluation, Potency and Activity). The resulting test was then administered individually to the experimental Ss, who were asked simply to judge the various traits against each of the semantic scales. This constituted the experimental condition employed during the first session of the experiment. During the second session, two modified versions of the test were administered. In one version, Ss were presented with the same traits as before followed in each instance by the word "mother", and were asked to judge the different kinds of mothers described by these traits against the semantic scales ("Mother" condition). In the second version, the word "father" appeared after each trait, and Ss were asked to judge the various fathers in an equivalent manner ("Father" condition). A counter-balanced order was used in administering these two experimental conditions.

For the first condition of the experiment (traits alone), marked differences in judgment were found between the individual traits for all three semantic factors. The experimental Ss thus demonstrated that they were able to differentiate the meanings of these traits in a highly discriminating manner. On the Evaluative factor of this condition, differences between groups were much less striking. Those differences which were present occurred primarily on traits of a rejecting, dominating and punitive character, and were largely attributable to the deviant judgments of the Drug Poores. This group tended to judge these traits in a uniformly more positively evaluated direction than any of the other groups.

More striking group differences occurred on both the Potency and Activity factors. Again, these differences were especially pronounced for negatively toned traits of a rejecting, dominating and punitive character. Of the various groups, the Non-Drug Poores deviated most markedly from the other groups in judging these traits. This group rated such traits as much more potent and active than the other groups. While the remaining groups did not differ markedly from each other in their judgments, there was a tendency for the Normals to give the least potent and active ratings of the various groups. Intergroup differences were much less pronounced for the positively toned, affectional traits. However, the Non-Drug Goods generally rated these traits as more potent and active than the other groups, while the Drug Goods tended to judge the same traits in the least potent and active direction.

The Mother and Father conditions served mainly to



confirm the results of the first experimental condition, while adding little additional information. The performance of the various groups on all three conditions was quite similar, and there were few gross variations in the inter-relationships of the individual groups from one condition to another. Differences between conditions tended to be quite general for all groups. These differences appeared to be a function of basic psychological processes and universal cultural determinants of semantic judgments.

Microfilm \$3.20; Xerox \$11.00. 248 pages.

# THE EFFECTS OF MAZE, AGE, AND SEX ON THE RELATIONSHIP BETWEEN HUNGER AND EXPLORATORY BEHAVIOR

(L. C. Card No. Mic 59-207)

Susan Gross Foster, Ph.D.  
Northwestern University, 1958

Supervisor: Janet A. Taylor

An experiment was performed to study the effects of sex, age, maze complexity, and response measure on the relationship between varying intervals of food deprivation and exploratory behavior in the albino rat. Such a study seemed necessary in view of the conflicting results of other investigators in this area. The Ss were 160 albino rats divided equally into 32 groups based on sex, two ages (60 and 100 days), two mazes (Simple and Complex), and four deprivation intervals (0, 24, 48, and 72 hours). Two response measures were used simultaneously to measure exploratory behavior: head-and-shoulder and body-length maze unit entries. The major results were treated statistically by analysis of variance. The principal findings were:

1. The age of the animal and the complexity of the maze are two variables that interact to determine the relationship between food deprivation and the amount of exploratory behavior.
2. Female rats explore more in a novel situation than male rats.
3. The age of the animal and maze complexity interact in their influence on exploratory behavior.
4. Exploratory behavior decreases as a function of time of exposure to a novel environment. Maze complexity and age of the animal influence the rate of decrement.
5. There is a difference in the results obtained by using the body-length or the head-and-shoulder response measure.
6. There is generally an inverse relationship between the amount of grooming and exploration.

On the basis of these findings it was possible to resolve certain apparent contradictions in the results obtained by other investigators. It was concluded that their differences resulted from their respective uses of the variables studied in this experiment. The complexity of interactions between the variables studied suggest that the whole area of exploratory behavior is considerably more complex than originally thought. Such theories as have to date appeared seem to be premature to the extent that the empirical relationships which they were designed to encompass lack the generality that has been attributed to them.

Microfilm \$2.00; Xerox \$4.40. 83 pages.

# THE ROLE OF SELF-RELATED-CONCEPT DISCREPANCIES IN PERSONAL ADJUSTMENT

(Publication No. 20,197)

Norman William Hickman, Ph.D.  
University of Oregon, 1957

Adviser: John Pierce-Jones

The problem which has been investigated in this research is one which involves a perceptual approach to the study of personal adjustment of college students. It is generally accepted that one's reaction to things is a function of how he perceives them. Furthermore, evidence has been accumulating to suggest that one's perception of things is colored by the concepts which he has of himself. Indeed theories have been developed to the effect that the self-concept constitutes the very core of personality organization. A logical consequence of such a theory is the assumption that personal adjustment problems occur as the result of threat to the integrity of one's self-concept.

It has been observed that a basic threat to one's self-concept occurs when he feels that he is being evaluated by others in a manner which is at variance with his concept of himself. It seems reasonable also that one may feel threatened when he finds his self-concept out of focus with other self-related-concepts such as the kind of person he would like to be, the manner in which he would like others to think of him, and perhaps the way in which he thinks of the "ordinary person." This kind of thinking suggests that one's strivings may represent an attempt on the part of the organism to maintain some sort of harmonious relationship among the various self-related-concepts. Thus it may be that the nature of one's personal adjustment is a reflection of his success or failure in maintaining a stable equilibrium among such concepts. If experimental evidence should support this formulation the implications for psychological theory and practice could be substantial.

The present investigation was designed to determine whether individuals differ in the size of the discrepancies among their various self-related-concepts and whether such differences, if found to exist, are significantly related to one's personal adjustment.

## Hypotheses to be Tested

The following four hypotheses were formulated for investigation. (1) When subjects are presented with a set of attributes with instructions to indicate (a) the way they see themselves (self-concept), (b) the kind of person they would like to be (ideal-self-concept), (c) the way they believe others see them (social-self-concept), (d) the way they would like to have others see them (social-self-ideal), and (e) the way they see the ordinary person (concept-of-the-ordinary-person) they will scale the attributes in such a manner as to reveal individual differences in discrepancies. (2) Subjects with better personal adjustment will scale the attributes in a manner which will reveal smaller total self-related-concept discrepancies than will those subjects with poorer personal adjustment. (3) Those subjects with more adequate personal adjustment will demonstrate smaller discrepancies between the various self-related-concept comparisons than will those with less adequate personal adjustment. (4) Subjects with better personal adjustment and those with poorer adjustment will



differ in the frequency with which they employ ratings which produce item discrepancies of given magnitudes.

For purposes of this study "self-related-concepts" were defined as any concepts held by the subject which relate to himself whether related directly by him or through projection onto others. This particular investigation was concerned with five self-related-concepts each of which was operationally defined by the manner in which the subject scaled the sample of attributes when confronted with appropriate instructions. The definitions follow.

- (a) The self-concept (SC) is defined as the way in which the subject says he thinks of himself.
- (b) The ideal-self-concept (ISC) is the manner in which the subject says he would like to think of himself.
- (c) The social-self-concept (SSC) is represented by the way in which the subject says he thinks his peers evaluate him.
- (d) The social-self-ideal (SSI) is the way the subject says he would like to be thought of by his peers.
- (e) The concept-of-the-ordinary-person (COP) is defined by the way in which the subject says he thinks of people in general.

### Method

#### Subjects

The 185 subjects whose records are included in this investigation were selected according to a table of random numbers from an initial population of 290 freshmen at Lewis and Clark College in the Fall of 1954. The final sample included 98 women with a mean age of 18.7 and 87 men with a mean age of 19.2 years.

#### The Attribute Scale

The Attribute Scale was composed of 80 items selected at random from a universe of self-perceptions totaling 950 items. The original items were compiled from statements made by clients, from counseling case-books, from personality inventories, and from special interviews.

The items in the final scale were arranged in random order and mimeographed for group administration. The same items were presented to the subjects five different times with different sets of instructions. Ratings were recorded on separate answer sheets composed of 80 graphic rating scales. All SRC Scale scores had reliability coefficients of .87 or higher.

#### The Criterion Instruments

Two instruments were used as criteria of adjustment. A special total score was derived and validated for the Minnesota Multiphasic Personality Inventory. A total score was used on the Harrower Multiple Choice Rorschach which was represented by the percentage of total responses classified as "poor" ones.

#### Procedure

The group form of the MMPI was administered to all of the subjects with separate answer sheets being used. The revised Harrower Multiple Choice Rorschach was

administered to all subjects using 35mm double frame slides for projection of the blots. The tests were given during special periods set aside for this specific purpose.

The Attribute Scales were administered to all subjects during special testing sessions. The scales were presented five different times at the same session with instructions designed to provide the examiner with information about the subject's various self-related-concepts. The scales were administered in the following order: (1) the self-concept, (2) the ideal-self-concept, (3) the social-self-concept, (4) the social-self-ideal, and (5) the concept-of-the-ordinary-person. Thus we were provided with five different numerical ratings for each subject. Ratings of this sort permitted calculation of ten sets of discrepancies among the various combinations of the ratings for each subject.

Following the administration of the Rorschach the subjects' personal adjustment scores were put into a frequency distribution. Twenty-seven per cent of the cases were cut from each tail of the distribution and labeled as the "high" and "low" groups or the "poorly adjusted" and the "well adjusted" respectively. The same procedure was followed with the MMPI so that each test separately could be used as a criterion of adjustment.

After the high and low groups were established for the Rorschach and for the MMPI the Attribute Scale records for those subjects were pulled from the total sample so that the discrepancy scores could be compared to their performance on the criterion instruments.

### Results

Hypothesis Number 1 was supported by the data. By inspection it was apparent that there were individual differences in the size of SRC discrepancies. Furthermore, since there were significant differences between the mean discrepancies of the high and low groups it is clear that there were differences among individuals composing the two groups.

Hypothesis Number 2 was supported by the evidence. The size of the total discrepancy score discriminated between the groups being compared regardless of whether the instrument being used as a criterion of personal adjustment was the MMPI, the Rorschach, or a combination of the two. In three comparisons out of four the differences were significant at the one per cent level of confidence while the fourth was significant at the five per cent level.

Hypothesis Number 3 generally was supported by the data. The differences between the two groups were significant at better than the five per cent level on 8 of the 10 SRC relationships. This was true when the MMPI, the Rorschach, or a combination of the two was used as a criterion of personal adjustment. However, when any given criterion was considered alone the results were somewhat different and it has been suggested that this fact may have important implications. Generally the SRC discrepancies are more highly correlated with the MMPI than with the Rorschach.

Hypothesis Number 4 was partially supported by the evidence. Neither the high nor the low group tended to accumulate a significantly higher number of discrepancies of the order of 0, 1, or 2. Neither did they differ in their use of ratings which produce item discrepancies of the



order of 6. However, there was a significant difference between the two groups in their use of ratings which result in discrepancies of the order of 3, 4, and 5.

#### Discussion

The results were discussed in some detail with special reference to the theoretical implications, the clinical applications, and suggestions for further research. The writer feels that this investigation will make some contribution in all of these areas.

Microfilm \$2.00; Xerox \$6.60. 136 pages. Mic 58-5232.

#### AN INVESTIGATION OF THE RELATIONSHIP BETWEEN CERTAIN PERSONALITY CHARACTERISTICS AND ACHIEVEMENT IN FRESHMAN ENGLISH COURSES AT THE OHIO STATE UNIVERSITY

(L. C. Card No. Mic 59-384)

Elizabeth Ann Wilson Hiscox, Ph.D.  
The Ohio State University, 1958

This study was designed to explore the possibility of isolating two personality types within the student population at The Ohio State University, on the basis of their ideological thinking and beliefs; and to determine whether the behavior patterns characteristic of the types so isolated were associated with achievement in a particular subject matter area. Two questions guided this research: (1) Is it possible to identify two personality types, the Stereopath (S) and the Non-Stereopath (N) within The Ohio State University student population on the basis of student's responses to the Stern Activities Index? (2) Will the students so classified differ in achievement in the freshman English courses?

The subjects employed in the first part of this study were students who were enrolled in English 418 during the Spring Quarter of 1958. Twelve sections of these classes were included (N = 284).

The students were classified into three groups, Stereopaths (S's), Non-Stereopaths (N's), and Others, on the basis of scores derived from their responses to a 300-item interest questionnaire. Responses were scored with discriminating item keys which had been established to distinguish between the S and N types. Based upon tentative cut-off points established on students at two other universities no clear-cut N types and only six S types were found within the sample studied. However, the distribution of scores indicated the likelihood of both types of students in the population at The Ohio State University with a higher proportion of S than N types.

To learn whether there was differential achievement between these groups in freshman English courses, analyses of variance of the discrepancies between obtained and predicted grade in each English course were performed for each of six student groups of various sizes. These groups included the male and female students classified as S's, N's, and Others, each taken separately in English 416, 417, and 418.

No significant differences in achievement in English 416, 417, and 418 were found between the students in any

of these six groups. Differences in achievement approached significance in only one group, the male students classified as N's, S's, and Others in English 417.

The first question of this study is, in general, answered positively. Both types of students appear to be present within The Ohio State University student population, with a higher proportion of S than N types.

The second question cannot be answered on the basis of this investigation. Although no significant differences in achievement in freshman English courses were found for any of the groups studied, it is thought that the restricted grade distribution for each of these English courses would perhaps obscure many differences which may possibly have been present. On the basis of these findings, it is not possible to state that the personality characteristics of the S and N types, as identified, produce differential performance in the freshman English courses at The Ohio State University.

Microfilm \$2.20; Xerox \$7.80. 168 pages.

#### SOME ASPECTS OF VERBAL STIMULUS GENERALIZATION IN HOSPITALIZED SCHIZOPHRENICS

(L. C. Card No. Mic 59-1278)

John Omar Kangas, Ph.D.  
University of Minnesota, 1958

This study investigated stimulus generalization in schizophrenia. It was contended that many of the hypotheses which have been advanced concerning the supposed thought defect in schizophrenia relate to the concept of stimulus generalization, and can be subjected to experimental test within that framework. Modifying Verplanck's definition, stimulus generalization is the behavioral fact that a response conditioned to one stimulus situation will be elicited by, or will occur in the presence of another stimulus situation although there has been no specific training to it. We speak of primary stimulus generalization when the "crude" sensory similarity of the two stimulus situations is predictive of the generalization; otherwise we speak of secondary stimulus generalization.

Four working hypotheses were derived from the psychiatric literature:

1. The schizophrenics show more primary stimulus generalization than normals.
2. The schizophrenics show less secondary stimulus generalization than normals.
3. A more generalized contextual defect disturbs the overall organization of thoughts in schizophrenia.
4. Most, if not all, of any apparent difference in stimulus generalization effects can be accounted for on the basis of differences in motivation, cooperation, attention, concentration, and distractibility.

The experimental design had the subjects attempt to identify previously learned words from a longer list of words including (a) words resembling them in graphic characteristics, from which a measure of primary stimulus generalization was derived; (b) words associatively related to them, from which a measure of secondary stimulus generalization was derived; and (c) control words



having neither of these relationships to the learned words but which are equally common in usage and which were used to correct the other experimental variables for guessing. Thirty-nine normal volunteers and thirty-nine hospitalized schizophrenics were studied. They were matched for age, education, intelligence, and association strength for the association word-learned word pairs used in this experiment.

The major findings are listed below:

1. Comparison of the two groups on a measure of learning (learned words minus control words) revealed that there was no difference between them on the first three trials on the experimental list. This suggests equal learning of the learned words. In subsequent trials, the schizophrenics performed more poorly than the normals. This was interpreted as an example of the schizophrenics' inability to sustain effort, attention, and concentration. To control this source of variance, only the performance of the groups on the first three trials was considered in subsequent analyses.

2. No difference was found between groups on the measure of primary stimulus generalization. This was interpreted as not supporting the hypothesis that schizophrenics are more concrete in their behavior.

3. The schizophrenics showed significantly more secondary stimulus generalization than did the normals. This finding was not considered consistent with the hypothesis that schizophrenics are unable to perceive abstract meaning relationships. If the schizophrenic is particularly guided by the characteristics ascribed to the unconscious, then this finding does not support Dollard and Miller's position that there should be less secondary stimulus generalization in the unconscious. In their experimental performance on this variable, the schizophrenics are not rejecting those abstract relationships that are inappropriate to the context of the task at hand as often as the normals. This was interpreted as a defect in regulatory mechanism which maintains a context-determined task orientation. The implications of this finding for a theory of the functioning of the higher mental processes were also discussed in terms of the need to look in the direction of more generalized context variables.

Microfilm \$2.35; Xerox \$8.20. 177 pages.

#### THE RELATION OF PATIENT-THERAPIST PERSONALITY SIMILARITY TO THE OUTCOME OF PSYCHOTHERAPY

(L. C. Card No. Mic 59-809)

John Henry Schopler, Ph.D.  
University of Colorado, 1958

Supervisor: Associate Professor Michael M. Wertheimer

The similarity of the interpersonal mechanisms of patients to those of their therapists was studied in relation to the outcome of therapy, in a group of 58 patients and 15 therapists. Both the therapists and the patients completed Leary's Interpersonal Check List. The therapists described themselves and five other therapists, while the patients completed the Check List for themselves,

their father or father figure, and an ideal person. Similarity, defined as the correspondence between Check List descriptions, was the independent variable and was measured in four related ways. The dependent variable, outcome of therapy, was measured by (1) the therapists' judgment of success and (2) the number of interviews attended by the patient.

For the measures of similarity of self-description involving the affiliative-hostile interpersonal dimension, the results were suggestive of a C-shaped curvilinear relation between similarity and success. It was not of a kind initially predicted, but was such that low similarity was associated with moderate success, while high similarity was associated with either high or low success. Because of the probable lack of independence involved in the ratings and similarity scores, it was difficult to find appropriate statistical tests that could be used for evaluating the curvilinearity. The tests employed did not yield probability values significant at standard acceptable levels, but showed only trends. These trends and a similar finding in the only other comparable study were viewed as warranting consideration of the curvilinear relation as a description of the relation between success and similarity. It was also possible to interpret the data from the few other studies which related similarity to success as consistent with such a curvilinear relation.

No relation was found between similarity of self-descriptions and number of interviews. Also, when similarity was defined as the correspondence between the patients' self-description and the ratings of the therapist by others, no relation was found with either success or number of interviews.

Incidental to the main hypotheses some other relations were studied. No relation was found between the similarity of the therapist to the patient's father or father figure and either success or number of interviews. One previous study had reported a negative trend between the therapists' liking of a patient and the similarity of the therapist to the patient's ideal; this trend was not replicated. The finding reported in two other studies, that patients' descriptions of an ideal stem from a strong stereotype, was corroborated.

A positive relation was found between the degree to which the therapist differentiated others' affiliative behaviors from his own and both average success and average patient time in treatment, but the degree of differentiation of dominance characteristics showed no relation to either success or length of stay. It was suggested that therapists who differentiate others' affiliative characteristics from their own might be less likely to use themselves as a frame of reference for reacting to their patients' behavior.

Microfilm \$2.30; Xerox \$8.00. 173 pages.



# AN INVESTIGATION OF THE PROBLEM SOLVING BEHAVIOR OF HIGH-GRADE MENTALLY DEFECTIVE CHILDREN

(L. C. Card No. Mic 59-811)

Robert Allen Spicer, Ph.D.  
University of Colorado, 1958

Supervisor: Professor Victor C. Raimy

Of the total population of mentally deficient persons (IQ and SQ below 75), seventy-five per cent are mildly retarded (i.e., IQ 55-75), and the majority of the latter are endogenous. In contrast to other forms of mental deficiency, these endogenous persons are characteristically free of brain damage symptoms and are found primarily in low socio-economic settings. These features have given rise to serious speculations concerning the mental potential of endogenous children as well as to possible etiological factors; e.g., a controversy has arisen around arrested development due to early, unfavorable learning conditions versus an immutable constitutional or genetic defect.

The results of deprivation studies, the reports of adverse environmental conditions in the history of endogenous children, and the lack of known genetic defect lend credence to the speculation that the kinds of early "learning" experiences of the endogenous children are critical factors in their low mental status. The present study was undertaken to investigate the effect of different incentives on problem solving behavior in high-grade defective children and normal children, and to contrive a learning situation that might provide clues about the origin and nature of these children's behavior.

Forty endogenous, mentally defective children (mean CA 12-1 and IQ 63) and forty-two normal children (mean CA 11-1 and IQ 109) were tested on two "non-verbal," multiple choice problems. On Problem I, all subjects were given verbal approval for correct responses until they reached a given performance criterion. On Problem II, using the same criterion, one-half of each group received verbal approval, and the other half received candy reward for correct responses. An individual count was kept of the number of trials required to reach criterion. These data provided a means for comparing normals and defectives for learning ability or problem solving on a specific task under two reward conditions.

It was predicted that due to the nature of the defective child's early learning experiences, candy would be a more effective incentive than verbal approval for him, and that on the experimental problem, the level of problem solving ability of the defective children with candy reward would be significantly less different than the normal children's ability. The obtained results were consistent with the predictions.

It was concluded that candy was more effective than verbal approval for eliciting effective learning on the experimental task in these defective children, while verbal approval was more effective than candy for normal children. On a much more tentative level, the results suggested the presence of some learning ability in the defective children that is not directly reflected in the Binet IQ.

It was speculated that the endogenous child's learning ability is a function of antecedent learning opportunities which might have been largely of a "performance" type

that required relatively limited use of words, and that his earlier problem solving behavior was not consistently and frequently rewarded by verbal approval. Poorly developed attending habits were discussed as possible contributing factors. The possibility of underdeveloped mental capacities as opposed to constitutional limitations was considered in light of the experimental results.

Additional research was indicated in the form of replication of the present study with groups of known brain damaged defective children; replications of the present study with a sampling of the experimenter variable; testing for the effects of verbal symbols in problem solving, testing for the effects of intermittent reinforcement with defective children, an experimental investigation of the distraction-attention variable, and testing for the effects of candy on a verbal task with defective children.

An attempt was made to interpret the results of the present study in terms of Harlow's theory of learning sets.

Microfilm \$2.00; Xerox \$4.80. 93 pages.

## THE DEFINITION AND MEASUREMENT OF CONFLICT IN TERMS OF P-TECHNIQUE: A TEST OF VALIDITY

(L. C. Card No. Mic 59-601)

Joseph Robert Williams, Ph.D.  
University of Illinois, 1958

An important problem in the scientific study of personality is the conceptualization and measurement of significant variables within its structure. The present investigation on the definition and measurement of conflict was an attempt in this direction.

Based on a review of theories, an analysis of conflict was made. Against this analysis, several existing methods of conflict-measurement were described and evaluated according to their conceptual adequacy. The attention given by each to the problem of validity was also studied. This review of methodologies failed to reveal a method that was entirely satisfactory from both standpoints.

The present investigation, therefore, had two aims: (1) to develop a methodology of conflict-measurement based on a logical and psychological definition of conflict, and (2) to test whether measures of conflict obtained by this method agreed significantly with those secured from independent criteria of conflict.

It was decided that the crucial problem in the measurement of conflict was to find a means of externally representing the 'compromising' or conciliatory feature of the internal struggle between tendencies. According to theory, the characteristic of conflict that demands a compromise on the part of the individual is that choice of one goal necessarily means (to him) some loss or sacrifice with respect to another. It seemed requisite, therefore, that the methodology developed be able to objectively reflect the considerations of gain and loss of satisfaction taking place as psychological events within the organism.

The general nature of the methodology used in this study is shown by the definition of conflict adopted. Conflict was defined as a state of competing ergic and / or sentiment structures, as revealed by the pattern of combined positive and negative factor loadings resulting from



P-Technique factor analysis of test results obtained with selected, dynamic attitude variables. This conception of conflict in factorial terms was derived from the suggestions and work of R. B. Cattell and students and has its theoretical origins in the writings of Freud and McDougall.

The main assumptions in the methodology of P-Technique factor analysis, as used in this study, are:

- (1) A factor analysis of measures obtained from tests made up of 'dynamic' statements of attitude and from any individual over a series of occasions yields an analysis of his motivational structure in terms of drives and sentiments.
- (2) The rotated factor matrix, as related to any attitude statement, gives, in spatial terminology, not only the motives aroused (goals sought) but also the degree of their arousal. That is, the signed factor loadings in the row of the matrix opposite the attitude statement may be said to refer to the individual's expectations with regard to gain and loss of satisfaction.
- (3) And, furthermore, summing this outcome (sum of positive and sum of negative loadings) for each of the attitude statements, in turn, gives the individual's total expectations with respect to gain and loss of satisfaction, to the extent that the statements selected are representative of the motivational domain of the person.

These total expectations in regard to gain and loss of satisfaction became the fundamental data for calculating 'degree of conflict' in any individual. Three different formulas (one offered by Brown and Farber, one by Cattell, and one developed in this study) were used to obtain a measure of conflict, and a comparison was made of the results given by each.

The validity of the methodology was tested by comparing the results with those obtained by several, external criteria of conflict. These criteria, and the corresponding hypothetical predictions, were as follows:

- (1) Hospitalized - non-hospitalized status of subjects. (The hospitalized will show significantly greater conflict.)
- (2) Psychiatric ratings. (There will be a significant, positive relationship.)
- (3) Responses to the "C," "Q<sub>3</sub>," and "Q<sub>4</sub>" sections of the 16 P.F. Test. (There will be a significant, negative relationship in the case of "C" and "Q<sub>3</sub>"; a significant, positive relationship in the case of "Q<sub>4</sub>.")
- (4) Responses to the "A" and "B" sections of the 16 P.F. Test. (Whether positive or negative, the relationship will not be significant.)
- (5) Instability as judged from facts in the life-history of the subjects. (There will be a significant, positive relationship.)

In carrying out the experimental procedures, fourteen 'dynamic' statements of attitude (eleven of them of known factorial content on the basis of previous research) were selected for test presentation. The ergic and sentiment structures represented, as earlier named, were "Sex," "Fear," "Parental Protection," "Self-sentiment," "Self-

assertion," and "Narcissism." The statements were administered in the form of three tests - preference, reaction-time, and fluency for 'good' and 'bad' consequences. All but one of twelve subjects (six mental hospital patients and six non-hospitalized persons judged to be relatively stable) were tested on each of forty occasions. The three separate, standard measures of attitude strength obtained on each occasion for each subject were combined to give a single measure of strength of interest in the course of action represented in each attitude statement for each occasion. The forty scores for each attitude for each subject were correlated with those for every other attitude. The resulting correlation matrix in each case was factored by the centroid method, and rotation to simple structure was carried out. Using the resulting data, degree of conflict for each subject was calculated by each of the three formulas mentioned above.

The non-parametric Mann-Whitney U Test was used in testing the significance of results in connection with the first hypothesis. In the case of each of the other hypotheses, three different tests of significance were employed. First, the product-moment  $r$  and the phi-coefficient were obtained and their significance evaluated by the  $t$  and chi-square tests, respectively. We also used the results from each criterion as a means of dividing the subjects into two groups, above and below the mean, and compared these results with those given by P-Technique, using the Mann-Whitney Test.

The results can be summarized as follows:

- (1) Two hypotheses (corresponding to predictions #1 and #4) were generally (in the main) confirmed.
- (2) Two hypotheses (corresponding to predictions #2 and #3) were confirmed, in part.
- (3) The hypothesis corresponding to prediction #5 was generally not confirmed.

Limitations and possible faults of the study were discussed. It was concluded that the results were sufficiently promising to warrant further testing. Suggestions for future research were made.

Microfilm \$3.75; Xerox \$12.80. 291 pages.

#### DEPENDENCY AND ULCER; DEPENDENCY AND FAMILIAL ATTITUDES IN PEPTIC ULCER AND CONTROL GROUPS

(Publication No. 24,458)

Milton Wilner, Ph.D.  
New York University, 1955

Adviser: Isidor Chein

An attempt was made to test Alexander's hypothesis of the specific role of dependency in relation to peptic ulcer. Thirty, white, male, native-born, adult veterans of the U.S. armed services were compared with 30 similar veterans who were chronically ill (non-ulcer patients) and with 30 similar veterans with no chronic illness. None of the 90 subjects had any history of psychiatric referral. The prediction was made that more ulcer patients would achieve extreme scores on tests of dependency and



of familial attitudes presumed to be related to a history of parental overprotection and/or rejection.

Two scales from Murray's questionnaire in *Explorations in Personality* (need Succorance and need Counter-Action), and the Navran Rationally Derived MMPI Scale to Measure Dependence were used as measures of dependency. The Elias Family Opinion Survey was used as a measure of familial warmth and, inferentially, of a history of parental overprotection and rejection.

The prediction was not supported, and further, some of the results were significantly in the direction opposite from what was predicted. On the test of familial attitudes, the ulcer cases differed significantly from the normal group and from the combined normal and (non-ulcer) sick control groups. On one test of dependency, the combined ulcer and sick groups differed significantly from the normal group. In all comparisons, the ulcer group contributed the fewest extreme scores.

The results may be interpreted as consistent with recent descriptions in the literature of ulcer populations as homogeneous, constricted, conventional and conforming, and with a recent characterization of psychosomatic patients, including ulcer patients, as "hypernormal."

The utility of a general concept like dependency as a psychogenic factor differentiating among various psychoneurotic and other psychologically maladjusted groups, including the more widely recognized psychosomatic disorders, was questioned.

Other results included:

a) The ulcer group differed from the control groups in familial attitudes and, by implication, indicated more frequent incidence of parental overprotection and rejection.

b) Group differences in reaction to statements about dependent behavior and feelings were of a nature that suggested that dependency may be a function of chronic illness rather than a specific psychogenic factor in peptic ulcer. The ulcer and chronically ill groups differed significantly from the normals, but not from each other, on the Navran scale and, although not statistically significant, there was a similar trend on the Murray need Counter-action questionnaire.

Microfilm \$2.00; Xerox \$4.20. 77 pages. Mic 58-5233.

## PSYCHOLOGY, EXPERIMENTAL

### TWO-CHOICE BEHAVIOR AS A FUNCTION OF THE DELAY BETWEEN RESPONSE AND PUNISHMENT

(L. C. Card No. Mic 59-201)

Donald Charles Butler, Ph.D.  
Northwestern University, 1958

In order to study delay of punishment, 80 albino rats were forced to choose between a left and a right turn (defined in terms of their initial bodily position). On each trial, S was placed in a compartment in the center of a grid floor. After 2 sec. the walls of the compartment were removed, permitting S to turn right or left. If S did not choose within 2 sec. he was forced by the raising of

a thin metal door, but without biasing his choice in favor of either response. In one set of five groups Ss received no shock if they turned in one direction, but if they turned in the other direction they were given a 2-sec. shock after delays, in different groups, of 0, 2, 4, 8, or 16 sec. Five groups in a second set were also shocked after the same delays for a turn in one direction, but in these groups the animals were shocked immediately if they turned in the other direction. All Ss were removed from the apparatus 20 sec. after choice.

Twenty-five trials were given on each of two successive days during acquisition, with a 30 sec. intertrial interval. Twenty-five "extinction" trials were given the next day, identical to acquisition in every respect except that no shock was administered. Turn direction, latency, and the number of non-forced choices were recorded. In the design of the study considerable care was taken to exclude any confounding effects of primary reward, or of secondary drive or aversion based upon a contiguous pairing of stimuli with shock.

In acquisition it was found that, when no shock was opposed to delayed shock, choice of the response followed by no shock increased with trials and decreased with delay; latency increased for all delays, but non-forced choices showed decreases only for the longer delays. When immediate shock was opposed to delayed shock, 0-sec. delay produced no consistency of choice, but longer delays were reliably preferred; latency increased and non-forced choices decreased equally for all groups.

In extinction, choices were consistently in favor of the response previously followed by no shock (vs. delayed shock) in one group, and delayed shock (vs. immediate shock) in the other. Non-forced choices increased with trials for all subgroups of both groups; latency decreased more with trials for the 0-sec. subgroup of each group.

The effects of delay were interpreted in terms of three variables: (a) overall aversion to apparatus cues, (b) differential aversion to stimuli concomitant with response, and (c) differential secondary reward upon response. One intervening variable, E', was defined as an increasing function of (b) and (c) and a decreasing function of (a); and another, L as the difference between (a) and E'. The definitions of these two variables were suggested by earlier hypotheses in the area and, when they were related to the response measures, they were moderately successful in explaining the results of the study.

Microfilm \$2.00; Xerox \$3.80. 70 pages.

### AN EXPERIMENTAL MODIFICATION OF FOOD PREFERENCE IN CHICKENS

(L. C. Card No. Mic 59-788)

Patrick John Capretta, Ph.D.  
University of Colorado, 1958

Supervisor: Associate Professor Maurice P. Smith

This study was designed to test whether the preferences for different colored foods could be altered by associating these foods with beneficial and noxious alimentary states.

Forty-eight chicks were given pre-training preference



tests to determine which of two foods they preferred. The foods were identical except that one was artificially colored red and the other artificially colored blue. The experimenter then attempted to alter the chicks' food preferences by associating these preferences with the beneficial and noxious alimentary states. This was done by force-feeding the chicks salt water, sweetened milk, or water immediately before they consumed their preferred or non-preferred foods. Force-feeding consisted of loading the chick's crop by means of a small catheter inserted through the chick's mouth and esophagus into the crop. In one group, the chicks were permitted to consume the colored food they preferred only after their crops were loaded with salt water, whereas on those training trials on which their non-preferred food was available, the Ss' crops were loaded with tap water. In a second group, the Ss were loaded with milk before their non-preferred food, and with tap water prior to their preferred food. The Ss, in a third group, were loaded with salt water prior to their preferred food, and with milk prior to their non-preferred food. Two control groups were loaded with tap water before receiving each of the two colored foods. The salt loads appeared to make the Ss slightly ill, whereas the milk and water loads had no visible effects upon the chicks' well-being. The chicks ate significantly less food after the salt loadings than after the milk or water loadings.

Preference tests during training clearly indicated that the association of a salt load with a particular colored food led to a decreased preference for that food. The extent to which the preference was changed increased with additional training trials. Associating a milk load with consumption of a colored food did not alter the preference value of that food. The control groups showed no consistent changes in preference with training. Three weeks after the completion of training, the preferences of the salt groups were almost identical to the preferences they demonstrated at the end of training. The other groups did not maintain the preferences shown at the end of training.

It is concluded that food preference can be reduced as the result of pairing the consumption of that food with noxious alimentary states, such as results from loading with salt water. Associating a beneficial condition with food consumption did not alter the preference value of the food. Several possible explanations were offered for this negative finding.

Microfilm \$2.00; Xerox \$4.00. 74 pages.

#### SECONDARY REINFORCEMENT AND SHOCK TERMINATION

(L. C. Card No. Mic 59-492)

William Frederick Crowder, Ph.D.  
University of Illinois, 1958

Four experiments were performed to test the hypothesis that stimuli paired with shock termination become secondary reinforcers. In all experiments, rats were confined in small cages, and shock was applied through electrodes attached to the tail. An auditory and/or visual stimuli preceded shock cessation. The front wall of the cage contained a circular opening, behind which was a panel to be operated by the animal's nose.

Experiment I used a white noise signal to "bridge" a two second delay in shock termination following the panel response. The first response after shock onset produced the signal, which lasted until the shock ceased. Whenever a response was made during the delay interval, the shock offset was postponed for two seconds. By preceding shock termination, the signal should have acquired secondary reinforcing power, and thus should have provided immediate reinforcement of the panel response. A group of 17 rats which received this "bridging" signal was found to improve more than a group of 19 control rats, trained with the same delay of shock cessation but without the signal. This difference reached only the .069 level of significance, however.

Experiments II and III used a 0.5 sec. auditory and visual stimulus to retard extinction. Rats were trained to turn off shock, and were then extinguished. The experimental animals received the signal for each reinforced response during training, and for all responses during extinction. In each experiment, 100 training trials were given, followed by eight minutes of extinction in the presence of shock. In Experiment II, shock built up gradually and could not be terminated by the subject until it had reached maximum intensity. The 30 experimental animals responded significantly more during extinction than did 30 control animals which received the signal only during training or 30 other controls which received the signal only during the four 2-min. periods of extinction. The signal was also employed to recondition the response after it had been extinguished for eight minutes. The control group which had been trained with and extinguished without the signal now received the signal for each response. The other two groups served as controls, no longer receiving the signal. During that period, the median number of responses in the reconditioned group was more than two and one-half times as great as either control group median. Experiment III was similar except that it employed instantaneous shock onset and a single extinction period lasting eight minutes. No significant difference was found between 20 experimental and 20 control rats, the latter receiving the signal during extinction only.

In Experiment IV, an auditory and visual signal preceded the termination of 100 inescapable random-length shocks, lasting between 8 and 120 sec. Eight 2-min. test periods were then given, during four of which each response produced the signal. Shock was presented continuously during the extinction periods in Experiments II and III. The ratio of response frequencies during "signal" trials to corresponding "no-signal" frequencies was virtually the same for the 16 experimental animals as for 16 control subjects, for which the signal and the shock termination had not been paired. Taken together, the studies appeared to provide only weak evidence that a stimulus paired with shock termination becomes a secondary reward. Microfilm \$2.00; Xerox \$3.00. 48 pages.



OBSERVATIONAL LEARNING IN  
THE RHESUS MONKEY

(L. C. Card No. Mic 58-5130)

Charles Lord Darby, Ph.D.  
Emory University, 1957

The term "observational learning" may be employed when the solution of a problem is achieved through or facilitated by one animal's observation of the performance of another animal. This term encompasses more than has traditionally been meant by the term imitation, which refers to a problem solution resulting from one animal's executing the same act as another animal. Observational learning is a broader concept in that it incorporates any facilitation in learning, whether it involves mimicry or not. The sole requirement for a demonstration of observational learning is that performance by one animal following observation of another animal be modified by that observation.

The results of studies dealing with this form of learning are ambiguous and, for this reason, two experiments were designed toward a more nearly unequivocal demonstration of such learning.

In Experiment 1, eight rhesus monkeys with extensive experience in discrimination learning situations were used as subjects. They were placed side-by-side in an apparatus which allowed each animal to observe the response of the other animal to an object-quality discrimination problem. The subjects alternated in the roles of demonstrator and observer. The observer watched the demonstrator respond to a problem, the response being rewarded and not rewarded approximately equally often. The observer was then given an opportunity to respond to the same problem. The observer's responses were correct significantly more often than was the case for the demonstrator. This furnishes clear evidence for the existence of observational learning. The superiority of the observing animal's performance was apparent within the first 30 problems and no further improvement was shown for the remaining 390 problems.

The second experiment was different in two respects from the first. These subjects had no previous experience in discrimination learning situations. Also face-to-face placement was substituted for side-by-side placement. In other regards, the two experiments were similar. The existence of observational learning was afforded additional support by the results of Experiment 2. The observer's first-trial performance rose from an initial level of 50 per cent correct to 75 per cent correct in the 500 problems allowed. This was significantly superior to what would be expected had no observation been allowed.

Additional data revealed that, for sophisticated animals, one observation trial is as effective as two or three. Whether the demonstrator's response was rewarded or not was immaterial to the correctness of the observer's response. Microfilm \$2.00; Xerox \$4.60. 89 pages.

DIMENSIONS OF STIMULATION AND  
DIMENSIONS OF EXPERIENCE

(L. C. Card No. Mic 59-825)

Albert J. Dinnerstein, Ph.D.  
University of Colorado, 1958

Supervisor: Associate Professor Howard E. Gruber

A dimension of perceptual discrimination (DPD) is defined as a class of mutually exclusive perceptual qualities. Examples of DPDs are chromatic colors, aesthetic reactions, or experienced magnitudes. A color can be experienced as red or green or purple. An object may be ten feet long or one foot long. Unlike the selection of qualities within a DPD, the selection of DPDs is not an exclusive choice, for a number of DPDs can coexist in experience. Different DPDs can vary in insistence or salience reflecting both the cognitive state of the observer and properties of the stimulus. The present concern is with the effects of the stimulus.

Traditionally, interest in the discrimination of qualities within a DPD led to psychophysical methods characterized by restriction of S's attention and report to a single DPD. The study of the salience of DPDs required the development of a psychophysics of free response, characterized by minimal restriction of S's attention and report. This free response method involves (a) presentation of stimulus without prior instruction, (b) request for free description, and (c) directed inquiry of S's memory of the stimulus. The salience of DPDs is inferred from the frequency with which they are reported in free description and by the willingness of S to make retrospective discriminations on these DPDs.

The method was demonstrated by an analysis of descriptions of pairs of triangles. The triangles in a pair differed in size and on three other stimulus dimensions. Five groups of Ss, 35 in a group, were presented different size ratios. Differences on other stimulus dimensions were held constant. Blind analysis of reports on five DPDs yielded highly reliable results and demonstrated that: (a) The salience of the size DPD varied directly with the magnitude of difference in stimulus size. (b) The total number of dimensions reported remained constant over stimulus conditions, suggesting that increased salience of one DPD correspondingly decreased salience of others.

The concept of response dimensionality, and the free response psychophysics were then applied to the recent controversy between Hochberg and Ittelson concerning the role of relative size and familiar size in the perception of distance. It was suggested that insufficient attention had been paid to the variety of different dimensions of distance discrimination. Three DPDs of distance were described: absolute distance, organization of depth, and magnitude of depth. Absolute distance refers to perceived distance from object to observer; organization of depth refers to the ordering of objects relative to the observer; and magnitude of depth refers to the ratio of estimated magnitudes of distance. Experiments were performed, manipulating the stimulus dimensions of image size, familiar size, and shape identity in order to determine their effects on the salience of the depth DPDs and on S's discriminations within these DPDs. The most noteworthy result was the observation that the salience of distance



relations and the occurrence of perceived three dimensionality were increased by image size difference even when the images represented two objects at the same distance. Neither shape identity nor represented distance contributed to the above effect, although represented distance usually did determine which one of the two objects looked closer. These studies also demonstrated that the salience of the depth DPD shows a different relation to the stimulus conditions than do any of the qualities within that DPD, indicating that the measured salience of a DPD is not merely a reflection of the prominence of specific qualities.

It was concluded that the free response psychophysics is a practical research tool, and that DPD salience reflects a combination of both perceptual and cognitive phenomena.

The concept of DPD salience and the free response psychophysics are not only interesting in their own right, but are also relevant to theories of thinking and personality. A study of the effect of the stimulus on perceptual response dimensionality can serve as a bridge between studies of perception and studies of other psychological events. Microfilm \$2.00; Xerox \$4.20. 80 pages.

#### THE EFFECTS OF SOME VARIABLES ON CHOICE BEHAVIOR IN DISCRIMINATION LEARNING

(L. C. Card No. Mic 59-796)

Charles Dennis Fink, Ph.D.  
University of Colorado, 1958

Supervisor: Associate Professor Maurice P. Smith

The purpose of this thesis was to study the relationship between learning based on one aspect of a stimulus compound and: (1) The amount of previous rewarded experience with a second aspect of the stimulus compound; (2) The amount of training during which both stimulus aspects are associated with reward; and (3) The relative innate distinctiveness of the two stimulus aspects.

Four groups of hooded rats were given either 50 or 150 training trials on a successive discrimination problem during which color cues were systematically associated with food reward. All subjects were then given 160 trials of compound stimulus training on a simultaneous discrimination problem during which both the color cues and an additional set of chain cues were systematically associated with food reward. Five sets of opposition tests were administered during this training--the first set after the fortieth simultaneous discrimination trial, and one set after each subsequent block of 30 discrimination trials. The results showed that: (1) Groups which received 150 successive discrimination trials: (a) made fewer errors during the initial trials of compound stimulus training than did groups receiving 50 trials; and (b) did not differ appreciably from the 50 trial groups with respect to the number of choices made to the positive color or chain cues during the opposition tests; and (2) During the opposition tests, all groups showed a consistent preference for the color cue which had been positive during successive discrimination training, and the degree of this preference increased as compound stimulus training proceeded.

In a second experiment hooded rats received either 10 or 90 training trials on a simultaneous discrimination problem during which either color cues or floor-barrier cues were systematically associated with food reward. Using the same discrimination problem, the subjects were then given either 5, 15, 45, 90 or 150 trials of compound stimulus training during which both color cues and floor-barrier cues were systematically associated with reward. The cues which had been relevant during the first stage of discrimination training were then removed and 50 test trials of simultaneous discrimination training were administered with the significance of the remaining cues unchanged. The results revealed that: (1) Groups which received 90 training trials prior to compound stimulus training: (a) made fewer errors during compound stimulus training than did the 10 trial groups; and (b) did not differ significantly from the 10 trial groups with respect to the number of errors made during the 50 test trials; (2) The number of correct choices made during the test trials was positively related to: (a) the number of trials received during compound stimulus training; and (b) the innate distinctiveness of the stimulus compound positive during compound stimulus training.

It was concluded that: (1) Differences in a set to respond on the basis of one aspect of a stimulus compound do not influence the amount of learning to other equally relevant and innately distinctive aspects of the stimulus compound; and (2) During compound stimulus training, the amount of learning which occurs on the basis of cues added during compound stimulus training is a continuously increasing function of the amount of compound stimulus training; (3) The amount of learning to cues added during compound stimulus training is related to: (a) the relative difference in innate distinctiveness amount the cues contained in the positive compound stimulus; and (b) the relative difference in innate distinctiveness between the positive and negative compound stimuli; and (4) When dealing with cues which differ in innate distinctiveness, acquired distinctiveness may account for temporary differences in learning rates and cue preferences, but differences after large amounts of compound stimulus training should be attributed to differences in the innate distinctiveness of the cues. Microfilm \$2.00; Xerox \$5.20. 102 pages.

#### SOME DETERMINANTS OF RADIO DRAMA PREFERENCE

(L. C. Card No. Mic 59-532)

Gordon Merle Keswick, Ph.D.  
University of Illinois, 1958

The interpretation and evaluation of radio drama programs was thought to reside in the broader issue of the individual's perceptual and self-equilibrating requirements. Self-equilibration, as expressed in the stability of personality, attitudes, and values, was regarded as the implicit goal of all human behavior.

In superficial contrast to that goal, the myriad variation in human behavior was viewed as a manifestation of an increasingly integrated perceptual process involving the selection of self-stabilizing alternatives from among available stimulus meanings. This process was viewed



in terms of mediation learning theory, according to which the individual develops self-stimulating neural representations of the meaning of the surrounding environment, eventuating in the perceptual definitions that serve both the stimulus interpretation and self-protective needs of the individual.

Relating this theory to drama program evaluation, it was assumed that the perceived relation between individual perceptual definitions of social roles and their concrete counterparts in drama programs would constitute a central basis: for rigid individuals' evaluation of the programs (first hypothesis), for causing persons of high perceptual rigidity to impose their social role preconceptions on the interpretation of drama characters (second hypothesis), and for producing shifts in post-measured attitudes toward social roles (third hypothesis) in the direction of character perceptions (fourth hypothesis).

Dividing 215 high school students into two groups, the semantic differential was used to profile social role meanings before and after exposure to two test radio drama programs, as well as to profile drama characters immediately following the program. In addition, Form 40 of the authoritarian "F" scale was used to index perceptual rigidity, and a special questionnaire to measure acceptance of the test dramas.

The data failed to support the hypothesized dependence of program evaluation on perceived discrepancies between social roles and drama characters for subjects with or without the perceptual rigidity characteristic, for the probable reason that the discrepancies were sufficiently small to keep perceived social role-character associations within the range of credibility. Sufficiently large discrepancies might arouse feelings of incredulity and prompt rejection of both the characters and the program.

Highly rigid subjects appeared to impose their social role preconceptions on the characters, as hypothesized, in only one of the two programs. Even in this instance, significant correlations were not at a useful predictive level. For this, and the reason that supplementary data investigations failed to produce a clear-cut explanation for the discrepancies between the programs, it was concluded that the "F" scale contributed more to doubt of its validity as a generalized measure of rigidity than it did to the drama research.

Based on a general conception of the principle of attitude congruity, the attitude scales of the semantic differential were used to test the third and fourth hypotheses. Greater social role-character attitude discrepancies were significantly associated with greater pre- to post-role attitude changes with minor exceptions. Change was in the hypothesized direction of character ratings in every instance.

In a supplementary analysis, according to precise congruity formulae, obtained role attitude changes were found to be highly consistent with predicted directions and relative magnitudes, including the instances excepted by the less sensitive correlation method applied to the third hypothesis. The superior efficiency and predictive value of the attitude congruity model is indicated.

Microfilm \$2.00; Xerox \$4.20. 80 pages.

## AMOUNT OF CONDITIONING AND INTENSITY OF CONDITIONED STIMULUS

(L. C. Card No. Mic 59-867)

Herbert D. Kimmel, Ph.D.

University of Southern California, 1958

Chairman: Professor W. W. Grings

This study tested three hypotheses regarding the role of intensity of the conditioned stimulus in classical conditioning: (1) amount of conditioning would vary as a function of intensity of conditioned stimulus (CS), with unconditioned stimulus (US) intensity constant; (2) amount of response during extinction would vary as a function of CS intensity, with intensity of the extinction stimulus (ES) controlled; and (3) amount of conditioning would vary as a function of the conditioned response/unconditioned response ratio (CR/UR ratio).

Ninety-six undergraduates with normal hearing were subjects. They were assigned randomly to eight equal-sized groups. Five groups (experimental) received a delayed conditioning procedure, with twenty paired presentations of a 1,000 cps tone delivered via earphones as CS and electric shock to the forearm as US. Four seconds separated onsets of CS and US. The CS intensities were 35, 55, 75, 95, and 115 db (all db re. .0002 dynes/cm<sup>2</sup>). The remaining groups (control) received the weakest, middle, and strongest intensities on twenty trials but with twenty electric shocks unsystematically interspersed. For control groups the CS and US were never paired as they were for the experimental groups. All groups received six extinction trials with one of three ESs, 45, 75, and 105 db. The response measured was the palmar GSR transformed into square root of conductance change.

**Results.** Hypothesis 1 and 3 were confirmed, lending support for the Pavlov-Razran theory of conditioning. The test of hypothesis 2 was inconclusive.

The 35 db intensity led to significant conditioning, but the remaining CS intensities did not. The conditioning effect in the 35 db group was noticeable in the first eight trials and vanished thereafter. The 95 and 115 db intensities appeared to produce pseudoconditioning effects in experimental and control subjects.

A CR/UR ratio of from 0.41 to 0.60 appeared to produce maximum conditioning. For subjects who showed significant conditioning, a significant correlation between CR/UR ratio and amount of conditioning ( $Rho = 0.74$ ) occurred.

The 35 db CS was associated with the highest amount of response during extinction, but this effect was confounded with a very significant effect of direction in change in intensity (from acquisition to extinction). This confounding left the extinction hypothesis unresolved.

**Conclusions.** Three factors were proposed to integrate the data: (1) A conditioning effect occurring only in the 35 db group; higher intensities led to interference with GSR conditioning; (2) a pseudoconditioning effect resulting from the 95 and 115 db intensities; (3) an adaptation effect occurring for all groups and obscuring differences among them during later trials.

Microfilm \$2.00; Xerox \$6.00. 123 pages.



## GREGARIOUS BEHAVIOR IN MALE MICE

(L. C. Card No. Mic 58-5159)

Girard Wallace Levy, Ph.D.  
Emory University, 1958

Gregariousness is an important aspect of social behavior. It has been defined by two criteria: (a) physical proximity of organisms greater than would be expected by chance, and (b) aggregation which is not in response to common environmental stimuli. Thus far, few studies have clearly satisfied these criteria, and little or no attention has been given to the factors which influence gregariousness. Six experiments were conducted to determine if mice show greater-than-chance approach to other mice, and to explore some of the factors which influence such approach behavior, if it occurs.

The general procedure was to compare the amount of approach behavior to an empty compartment with the amount of approach behavior toward a compartment containing another mouse, or a suitable control object. It was shown that the tendency to approach another mouse was greater than would be expected by chance or by a response to inanimate stimuli.

Significant amounts of approach behavior were observed in three experiments, and evidence of reaction to the presence of another mouse, although not uniformly approach behavior, was observed in all six studies. The following factors were found to influence approach behavior:

1. Size (Mice showed significant approach to a small male mouse, but not to a large male mouse.),
2. Shape (Mice showed significant approach to a live mouse or model of a mouse, but not to an inanimate object which lacked a mouse-like shape.).

The following factors did not have any significant effect upon approach behavior in our experiments:

1. Coat color (Mice showed significant approach to both a black and an albino male mouse.),
2. Movement (Mice showed significant approach to both a live mouse and a model of a mouse.),
3. Length of isolation prior to test (There were no significant differences in approach behavior among mice isolated for 0, 2, 4, 8, 16, and 32 days before observation.),
4. Genetic differences (There were no significant differences in approach between C-57 black and A-strain albino mice.),
5. Odor (There were no significant differences in approach to a strange male, presented with and without a particular odor, nor did raising a group of mice on the test odor appear to influence their approach to the odor or to a strange mouse presented with the odor.),
6. Sexual-aggressive motivation (Normal and castrated mice, without previous sexual or aggressive experience, showed significant approach to another mouse, and the degree of approach behavior observed did not correlate significantly with the aggressiveness of the subjects, as later measured in a different situation.).

The approach behavior observed in our experiments differs from approach behavior motivated by curiosity and exploration both in degree of approach (approach to another animal was greater than approach to a novel object), and course of adaptation of the approach behavior. There is no evidence that social approach behavior undergoes

satiation, either within a test session, or between daily test sessions.

The experiments suggest that the subjects are reacting more to the presence of another mouse than to the presence of a particular mouse. The term "proto-social behavior" was proposed to describe this level of social interaction. Microfilm \$2.00; Xerox \$6.40. 132 pages.

## RELATIONSHIPS BETWEEN SOCIAL NEED STRIVINGS AND THE DEVELOPMENT OF HETEROSEXUAL AFFILIATIONS

(Publication No. 24,135)

William J. Meyer, Ph.D.  
Syracuse University, 1957

The primary purpose of this investigation was to examine the developmental relationships believed to exist between two social-psychological needs and the social relations structure existing between boys and girls during preadolescence and adolescence.

In order to measure the sex differences in perceived need satisfying abilities, the Syracuse Scales of Social Relations were used. On this sociometric instrument, the subjects are required to rate all the members of their group in terms of a hypothetical social situation constructed in such manner that it is directly related to a particular social-psychological need. Two such needs were developed in the present study which it was believed would demonstrate two contrasting developmental relationships of sex cleavage. The investigator concluded on the basis of the research literature that the needs playmirth and succorance could be best satisfied by one sex over the other; boys being better able to satisfy playmirth needs and girls being better able to satisfy succorance needs.

Several hypotheses were developed which it was believed would cast light on the development of sex cleavage:

1. Males and females will rate their own sex higher in need satisfaction potential for each need.
2. The cross-sex ratings of males will be higher than similar ratings made by females.
3. Same sex ratings will be higher for the succorance situation than the playmirth situation.
4. Males will rate females higher on need succorance than on need playmirth.
5. The mean variability of ratings made and received will increase with age.
6. The variability of ratings made by males will be greater than the variability of ratings made by females.
7. The variability of ratings for need succorance will be greater than for need playmirth.

In addition the data were also analyzed in terms of the following developmental trends:

1. Grade-placement trends of mean ratings received by males from females on each need.



2. Grade-placement trends of mean ratings received by females from males on each need.
3. Grade-placement trends of mean ratings received by males from males on each need.
4. Grade-placement trends of mean ratings received by females from females on each need.
5. Grade-placement trends of mean ratings made by males of all their classmates for each need.
6. Grade-placement trends of mean ratings received by males from all their classmates for each need.
7. Grade-placement trends in mean ratings made by females of all classmates for each need.
8. Grade-placement trends of mean ratings received by females from all their classmates.
9. Grade-placement trends in the relationships between the two needs on ratings made.
10. Grade-placement trends in the relationships between the two needs on ratings received.

Experimental evidence pertinent to the foregoing hypotheses was collected by administering the sociometric scales to all the pupils in grades five through twelve in a central school in upstate New York. The majority of the children are from lower-middle income homes. The distributions of sex, age and intelligence are not unlike those expected in the average public school. It was felt that the children had in most cases sufficient opportunity to get to know each other well because, with the exception of transfers, they had all been in attendance at the same school building throughout their entire academic careers.

The experimental results of this study generally support the conclusion that each sex regards their same-sex classmates as being better able to satisfy their succorance and playmirth needs. The evidence also indicates that both same-sex and opposite-sex classmates are better able to satisfy playmirth needs than succorance needs. In addition it was found that boys rate their female classmates higher for each need situation than do the girls rate their male classmates.

The trend analysis indicates, with one notable exception, a downward trend of mean ratings for each need situation with increasing grade placement. The exception occurred for the mean ratings received by boys from their female classmates on the playmirth social situation. This trend was in the direction of increasing mean ratings from grade seven through ten and then a decrease. In addition, these data indicate that the boys and girls in this sample have a progressively poorer opinion of their classmates' ability to satisfy their succorance and playmirth needs.

Trend analyses of the variability indices support the conclusion that the subjects tended to increasingly restrict the range of their ratings with increasing grade placement. No reliable differences were found between the variability indices of boys and girls for either need situation. The variability indices for the playmirth situation were reliably higher than for the succorance situation.

Microfilm \$2.80; Xerox \$9.80. 215 pages. Mic 58-5234.

## THE ROLE OF REINFORCEMENT IN BEHAVIOR FIXATION

(L. C. Card No. Mic 58-5178)

James Preston Rogers, Jr., Ph.D.  
Emory University, 1956

The aim of the present study was to obtain experimental data which would permit us to evaluate opposing theoretical interpretations of fixated behavior. Two fundamentally different theories were examined: Maier's frustration theory, and contemporary reinforcement theory.

The subjects were 31 male albino rats. Training was given in three stages.

During Stage I, all subjects were given 300 trials in an insoluble shock-escape problem. The subject could escape shock by entering either of two alleys. These alleys were randomly lighted or dark. Regardless of which alley the subject entered, shock terminated immediately on approximately 50 per cent of the trials, and after eight seconds on remaining trials.

During Stage II, the subjects could achieve immediate shock-escape on every trial by selecting the correct alley. The designation of which alley was correct for any given subject was based on that subject's behavior during Stage I. Entries into the incorrect alley led to an eight-second delay of shock termination. During Stage II, which lasted 350 trials, 13 subjects learned, 16 developed fixations, and 2 failed to either learn or fixate; these latter two were dropped from the experiment.

The 16 fixated subjects were divided into two equal groups. During Stage III, the procedure was identical with that in Stage II except for the duration of shock following incorrect responses. For one group (Group L) shock continued for 32 seconds following incorrect responses; all of these subjects learned in Stage III. For the other group (Group S), shock continued only 2 seconds following incorrect responses; only one of these subjects learned in Stage III. The difference in the number of subjects in each group which learned is significant at the .001 level.

It was shown that Maier's frustration theory leads to the prediction that the subjects in Group L would not learn, and that the subjects in Group S might learn. Reinforcement theory leads to the prediction that subjects in Group L would learn, and that the subjects in Group S would be less likely to learn. Thus, our data clearly support a reinforcement learning interpretation of fixation. More specifically, our data support the anxiety-reduction theory suggested by Farber in preference to the excessive-habit-strength theory suggested by Wolpe.

Microfilm \$2.00; Xerox \$3.60. 63 pages.

## PAIRED-ASSOCIATE LEARNING AS A FUNCTION OF AMOUNT OF PRIOR EXPERIENCE WITH STIMULUS AND RESPONSE

(L. C. Card No. Mic 59-223)

Rudolph W. Schulz, Ph.D.  
Northwestern University, 1958

Supervisor: Benton J. Underwood

It was hypothesized that frequency of prior experience (n) with verbal materials might be an environmental



antecedent for the rated meaningfulness ( $m$ ) of these materials. A review of the available facts indicated this hypothesis to be generally tenable with the exception of the findings concerning the role of  $n$  in paired-associate learning. It was reasoned that if  $n$  was to be considered the antecedent of  $m$ , then it should be possible to show that the effect of  $m$  can be reproduced via manipulation of  $n$ . Therefore the following predictions, based on the findings with respect to  $m$ , were made concerning the expected result of manipulation of  $n$  in paired-associate learning. (a) Rate of paired-associate learning should be an increasing function of amount of  $n$ . (b) Response  $n$  should facilitate paired-associate learning more than stimulus  $n$ . An attempt was made to verify these predictions by means of an experiment involving the manipulation of the two independent variables amount of  $n$  and locus of  $n$ .

The experimental design consisted of a  $2 \times 4$  factorial arrangement in which locus and amount of  $n$  represented the two respective sources of classification. Thus there were eight treatment groups. Each group contained 24 Ss. The four stimulus  $n$  groups were given varying amounts of prior experience with the stimulus members of a subsequently learned paired-associate list of low association value nonsense syllables and no prior experience with the response members of this list. The four response  $n$  groups were given varying amounts of prior experience with the response members and no experience with the stimulus members. The variation in amount of prior experience consisted of 1, 10, 20, and 40 presentations of the appropriate syllables. The syllables were presented manually by E on  $3 \times 5$  cards at approximately a 2-sec. rate. The S was required to spell each syllable aloud as it was presented. Following the prior experience task S learned the experimental paired-associate list for 20 anticipation trials. This list was presented on a Patterson type memory drum at a 2:2 rate. The experimental session was divided into two 50-min. periods with 24-hr. between periods. In the first period S learned a practice list of paired-adjectives and received half of his prior experience. In the second period he received the remainder of his prior experience and learned the experimental paired-nonsense syllable list.

The results of the experiment may be summarized as follows:

1. Locus of  $n$  was a significant source of variance in paired-associate learning, both in terms of mean number of total correct responses and mean total number of trials required to reach the first correct response for all items in the list. Performance was better with response  $n$  than with stimulus  $n$  at all values of  $n$ .

2. Amount of  $n$  was not a significant variable in paired-associate learning when considered over-all. However amount of  $n$  and locus of  $n$  appeared to interact. Although this interaction was not statistically significant, the data suggested that facilitation due to response  $n$  was increasing as  $n$  increased while with stimulus  $n$  there was a tendency for performance to become poorer as  $n$  increased. The foregoing results were obtained with both mean total correct responses and mean total trials to reach the first correct response for all items in the list.

3. There were no significant differences in mean number of total overt error responses as a function of either locus or amount of  $n$  nor was any interaction apparent.

4. A qualitative classification of overt errors did however reveal that certain types of errors were related to variations in treatment.

It was concluded that the results concerning locus of  $n$  were clearly consonant with the hypothesized relationship between  $n$  and  $m$ . Similarly, the results regarding amount of response  $n$  agreed with the hypothesis. However, the finding that performance was apparently retarded by large amounts of stimulus  $n$  is contrary to the hypothesis. Rather than concluding the hypothesis untenable on the basis of this one unfavorable finding, an alternative interpretation was offered. It was suggested that this result may have been due to the type of list and method of giving prior experience used in the present experiment.

Microfilm \$2.00; Xerox \$4.40. 83 pages.

#### THE RELATIONS AMONG OPERANT RATE, FINAL EXTINCTION RATE AND DRIVE

(L. C. Card No. Mic 59-1300)

Evalyn Finn Segal, Ph.D.  
University of Minnesota, 1958

Adviser: Kenneth MacCorquodale

The objective of this research was to investigate properties of operant level of bar pressing and their relation to extinction and other behavior.

The significance of operant level resides in its role as the baseline of operant conditioning and extinction, conditioning being taken as an increase in frequency of occurrence of the response above operant level as a function of presentation of reinforcers, and extinction often being regarded as a decrease in frequency of occurrence back to operant level, as a result of permanent withdrawal of reinforcers.

Thirty daily operant level observations were made of 34 male albino rats. Measures were also obtained of animals' resting metabolic rates and of number of responses emitted for a light reinforcer, for 150 intermittently scheduled food reinforcers, and during 30 daily extinction sessions which followed conditioning.

Animals were divided into 6 groups: 3 groups, differing in percentage *ad lib.* weights at time of experimentation, were run in the first series of observations; another 3 groups, similar to the first, were run in the second series. The series differed in age of the animals, their living cages, their exact percentage *ad lib.* weights, and the number of apparatuses employed.

The specific questions addressed were (1) stability of operant level over time; (2) relation of operant level to resting metabolic rate; (3) effect of drive upon operant level; (4) relation of operant level to extinction responding and extinction asymptote; (5) effectiveness of light as a reinforcer; (6) relation of operant level to responding during light and food conditioning; (7) forms of group distributions of operant level measures; and (8) forms of group distributions of extinction scores and their relation to operant level distributions.

The results were; (1) Daily median operant level of each group fluctuated within narrow limits over 30 sessions. Operant level did not change appreciably from the first 15 sessions to the last 15; there was no systematic decline in operant level with increasing experience of the apparatus. Relative rankings of animals showed a small but significant concordance over sessions. (2) Operant



level showed no clear relation to rate of oxygen consumption. (3) Deprivation depressed operant level but enhanced extinction responding, relative to the behavior of satiated animals. There was evidence that moderate deprivation produced greater behavioral consistency than either satiation or severe deprivation. (4) Extinction responding remained well above operant levels during every extinction session. There was little decline in responding with progress of extinction. Short-term operant level-extinction concordance among relative rankings was good, but rank correlation between mean operant level and mean extinction score was poor. (5) Light reinforced bar pressing. The progressively greater effect with increasing drive was related to the Campbell-Sheffield hypothesis that deprivation lowers thresholds to external stimulation. (6) There was no relation between operant level and number of responses emitted for light and food reinforcers, except in one of the moderately deprived groups. (7) Distributions of operant level were positively skew. Modal frequency of responses per session was everywhere 0 to 2. Drive decreased skewness. (8) Distributions of extinction scores were more skew than those of operant level. Modes occurred, generally, between 0 and 6 responses per session. Drive increased skewness. Flattening of extinction distributions relative to operant level distributions was interpreted as a rise in probability of high response scores as a result of conditioning.

Microfilm \$2.05; Xerox \$7.40. 156 pages.

ACQUISITION AND TRANSFER PERFORMANCE  
IN A MOTOR TASK AS A FUNCTION OF  
VARIATION IN LEVEL OF RELEVANT  
SYMBOLIC INFORMATION

(L. C. Card No. Mic 59-727)

Sidney Seidenstein, Ph.D.  
The University of Wisconsin, 1959

Supervisor: Professor W. J. Brogden

In this study the effects of supplying additional information of a symbolic nature (arrows, numbers, a warning signal) on the performance of Ss learning a simple perceptual motor task were examined. The Ss were required to properly position a lever on target in order to turn out one of five lights on a display panel. Performance was measured in terms of the amount of time on target. The four levels of information (four experimental conditions) were: (1) distance and direction and time of appearance of the next light in the series with respect to the current one (2) distance and time (3) direction and time (4) time. In addition a control group of 40 Ss received no added information but performed the same basic task. The information was presented to S automatically on a display screen to the 40 Ss in each of the four experimental conditions  $1\frac{1}{2}$  seconds prior to the required change in position. On a second day half the Ss in each of the five conditions were shifted to either the maximum (1) or control conditions.

The results indicate that mean level of performance over all acquisition trials is a function of the level of information provided. Greater amounts of information

produce higher over-all performance. Initially performance is inversely related to level of information. Following practice Ss receiving higher levels of information improved more rapidly and reached a higher terminal level of performance.

An explanation of these findings is offered in terms of the effect of the information on the reaction time components of the required responses. It is suggested that information reduces the number of alternative response possibilities and produces shorter reaction times, in a manner analogous to the differences between simple and discrimination reaction time.

Transfer performance on the second day was found to be a function of the nature of the information provided. The Ss receiving maximum information performed better regardless of the type of information they received on the first day. Performance on the second day is also related to the differences in level of information received by the S on Day 1 and Day 2. Improvement in performance was found in those cases where S transferred to a higher level of information. It was hypothesized that performance changes are directly related to the amount of information added or subtracted in shifting to one of the two transfer conditions. Microfilm \$2.00; Xerox \$5.20. 102 pages.

GENERALIZATION AS A FUNCTION OF  
INTRALIST AND INTERLIST SIMILARITY USING  
GRADED STIMULI AND A SPATIAL RESPONSE

(L. C. Card No. Mic 59-228)

Curtis E. Thomsen, Ph.D.  
Northwestern University, 1958

Supervisor: Carl P. Duncan

The evidence for the several assigned properties of stimulus generalization has not always been consistent. This inconsistency may be due to any of several factors but two important factors probably are: (a) the stimulus materials employed, and (b) the response measures that are used. A different type of both stimulus material and response measure were therefore used in an attempt to obtain more evidence on generalization. The experiment was designed to study: (a) generalization as a function of the degree of intralist stimulus similarity (property one); (b) spontaneous recovery of generalization (property two); (c) the growth and decline of generalization during learning (property three); (d) generalization as a function of the simultaneous variation of intra- and interlist stimulus similarity (property four).

Matrices of nonsense figures were used to form lists of High, Medium, and Low intralist stimulus similarity and with High, Medium, and Low interlist stimulus similarity. Each of the stimuli from the lists was then assigned to a spatial position. The S had to learn the correct location of this spatial position for each stimulus. The discrepancy between his "guess" and the correct position constituted the basis for measuring generalization error.

The major findings and conclusions were as follows:

1) Property one: In learning, the higher the intralist similarity the more trials needed to learn. The generalization error was higher for High intralist similarity, but



the generalization error for the Low intralist similarity group was slightly higher than that of the Medium intralist similarity group.

An unusual finding was that there appeared to be an inverse relationship between the size of the variance for generalization error and the degree of intralist similarity. This suggested that the generalization processes may depend on the degree of intralist similarity under which  $S$  learns.

2) Property two: In recall and relearning, the number correct at recall was inversely related to intralist stimulus similarity while the number of trials to relearn was an increasing function of intralist similarity. The algebraic error for recall and the algebraic error during relearning, even though in the expected direction, were not significant. The results for property two were not easily interpretable since learning was not equal for the groups at the end of original learning.

An additional group of  $S$ s was run to compare with the Low intralist group. This control group "relearned" immediately instead of waiting 24 hours. The number of trials to relearn and the algebraic errors per trial during relearning were in the expected direction but were not significant.

3) Property three: The generalization error as a function of stage of learning was not statistically analyzed. By inspection, the curves for each intralist condition had two or more increases and decreases throughout the 10 stages of learning, suggesting that the growth and decline of generalization may not be the simple function ordinarily expressed.

There was an inverse relationship between the size of the variance of the highest algebraic error made during learning and the degree of intralist stimulus similarity.

4) Property four: The interaction between intralist and interlist stimulus similarity was significant, but the shapes of the functions obtained do not appear to be readily explainable. Neither the results for intralist similarity, nor those for interlist similarity, taken alone, could be meaningfully interpreted.

Microfilm \$2.00; Xerox \$5.20. 105 pages.

#### EFFECTS OF TIME-SET ON WORK OUTPUT

(L. C. Card No. Mic 59-1304)

Robert Mapes Thomson, Ph.D.  
University of Minnesota, 1958

The primary purpose of this study was to examine several relationships between time-set and work output. Time-set is defined as the particular aspect of the subject's attitude which refers specifically to the given length of time of the trial to be done, regardless of the total amount of work involved.

The given task involved continuous packing of spools on a modification of the Warner Brown spool-packing apparatus. Two groups of subjects were tested independently. The first group of 64 subjects were college undergraduate students. The second group of 36 was drawn

from industrial employees working on semi-skilled manual jobs. Both groups were given time-sets or trial lengths of 1-, 3-, 5-, and 10-minutes. The Student group was also given an additional time-set of 45-minutes; the Industry group one of 2 hours. Each group worked for one hour at the end of the practice trials.

Experimental design involved analysis of variance using replicated Latin squares. All cross-comparisons made between outputs for the different trials were equated with respect to elapsed time. Correlations were calculated between individual performances, and mean differences between performances on different trial lengths were compared with the  $SE_d$  between correlated means. Subjects were questioned at the end of the experiment regarding their attitudes toward the different lengths of trial and for estimates of their relative rates of work on these trials.

The initial rate of work was generally related inversely to the length of trial. Only the 1-minute task output for the Student group differed significantly (higher) from remaining trial performances. Throughout the results, actual differences between trial performances minute-by-minute were small --- generally under 1 percent after the first minute.

The initial minute in the work curve had the same characteristics for all trials: a sudden drop followed by a slight rise, and then a gradual tapering-off. The amount of the drop is generally related to the length of trial. The duration of the drop is shorter for the more experienced group. From minutes 3 to 5, the cumulative output of the 5-minute task significantly exceeds all other trial outputs.

The work curve continued to decelerate slowly, following the same approximate course for all trial lengths. For trials lasting one hour, the work rate leveled off between 20 and 30 minutes. The drop following the initial work rate was less steep and leveled out sooner for the more experienced Industry group.

Subjects distinguished consciously between different trial lengths, but differentiated no better than chance expectancy between performance rates for different trial lengths. Estimates by the more experienced Industry group were no better than those by the Student group.

The Industry group was inferior to the Student group in all phases of performance except for output beyond 10 minutes after the start of the one-hour trial. The superiority of the Student group increased with practice.

Subjects of both groups generally worked more efficiently on the 1-, 5-minute, and long trials than on the 3- and 10-minute trials. Also, their attitudes toward the former trials were more clearly formulated than for the latter.

It is proposed that:

1. "Efficient" trial lengths may be found for various types of work which can lead to higher total output at no additional energy expenditure, and which may be relatively unaffected by experience.

2. Over-all differences in work output for tasks of different lengths are foreshadowed by differences early in the work curves.

3. Recommendations are made for further studies directly applicable to industrial and other practical work situations. Microfilm \$3.00; Xerox \$10.40. 231 pages.



## RELIGION

### THE SOUTHERN BAPTIST SUNDAY SCHOOL BOARD'S PROGRAM OF CHURCH MUSIC

(Publication No. 24,482)

Floyd H. Patterson, Jr., Ph.D.  
George Peabody College for Teachers, 1957

A 3rd listing. Please see abstract on page 2583.  
Microfilm \$4.70; Xerox \$15.80. 366 pages. Mic 58-5230.

## SOCIAL PSYCHOLOGY

### DIFFERENCES IN SELF-PERCEPTION AMONG PHYSICALLY DEPENDENT DRUG ADDICTS, ALCOHOL ADDICTS, AND CONTROLS

(L. C. Card No. Mic 58-2807)

Morton Cooper, Ph.D.  
The American University, 1958

#### Statement of the Problem

The purpose of this investigation was to ascertain possible differences in the self-perception of incarcerated drug addicts and alcoholics by means of the Q-methodology. Twenty drug addicts, twenty alcoholics, and twenty non-addicted imprisoned individuals, all males, at the Lorton Reformatory in Virginia, were carefully selected and matched with one another by such criteria as age, intelligence, education, race, socio-economic background, type or nature of offense, and personality characteristics. The twenty non-addicted individuals were utilized as a "control" group, to rule out possible common factors that might apply to all three groups.

#### Procedure

All the subjects were instructed to sort 96 statements, formed in a balanced block design, under four different frames of reference — these being: (1) "self-actual" (2) "self-ideal" (3) how the subjects felt when they were "down in the dumps", or at their "worst" and (4) how they felt other individuals in general regarded them. The statements were composed empirically from personal contact with the inmates who represented the three groups under study, and from descriptive material in the literature.

It was the investigator's aim to experimentally test the hypotheses, proceeding hypothetico-deductively, that the drug addicts are more dependent; in greater need for immediate gratification; more inadequate; less sociable; have a lower toleration for pain; and direct more aggression toward themselves than the alcoholics. The expected

differences were to be of extent and degree, not of variety and kind. The alcoholics, similarly, were expected to score higher in those variables than the non-addicts. The drug addicts were also expected to account for a wider inconsistency in self-perceptions on the four sorts in contrast to the alcoholics and non-addicts. In turn, the alcoholics were to show more inconsistencies than the non-addicts.

#### Results

Analysis of variance techniques failed to support the hypotheses, as tests of significance did not show a differentiation between the three groups. As a matter of fact, there were surprising similarities in the inmate's self-perceptions. It would seem therefore, that personality descriptions of drug addicts and alcoholics in the literature are not at all like the self-perceptions of these individuals. The similarity in self-perceptions conforms, for the most part, with the unanimity of opinion concerning a common personality structure for the addicts and alcoholics. A low self-esteem attributed to them may very well exist, but again, is not recognized in their self-perceptions. The groups apparently perceived themselves as one would regard another on "casual observance".

#### Conclusions

Although no significant differences were found, two qualitative descriptions suggested by the data can be made from this study.

1. The drug addicts and control group on the four sorts consistently perceived themselves in a more favorable light than the alcoholics.
2. The alcoholic group tended to be more devaluative, even to the extent of rating only slight changes in their self-perceptions as they perceive themselves "actually," and how they regard themselves when at their "worst."

Microfilm \$2.00; Xerox \$5.60. 111 pages.



## A STUDY OF DECISION TIME IN CHILDREN

(L. C. Card No. Mic 59-680)

Mary Osborn Gallwey, Ph.D.  
Cornell University, 1958

This study investigated one aspect of children's responses in a situation where they could be proud or ashamed of their performances. Pride was defined as an emotional state resulting from the public display of a valued characteristic and shame as an emotional state resulting from public revelation of a negatively valued characteristic.

The performance displayed was accuracy in problem-solving. The response studied was decision time. The initial hypothesis was that children who regarded failure as relatively probable would spend longer, particularly in a public situation, in reaching decisions than children who viewed success as relatively probable. The slower performance was expected to result from the child's attempt to maximize the probability of success in the presence of an audience by taking greater care in decision making.

Each of 32 children from the fourth, fifth, and sixth grades of a public school performed two tasks. The children were matched on age and academic ability; half were boys, half girls. The first task was a set of modified items from Raven's *Progressive Matrices*. The child's estimate of the probability of success was influenced by the result of a pre-session in which he worked alone on a set of problems. At the end of this session, half of the children received success scores and half received failure scores. Half of the children in the success group and half in the failure group then performed a second set of solutions before an audience of two strange adults; the other children again worked alone. All children received success scores for this set. The second task followed immediately with the audience, if any, remaining. It was a series of twenty line discriminations. After each judgment the child was informed by a light whether he had been right or wrong. Twelve sets of lines were actually equal in length. The child's estimate of the probability of success was expected to vary according to whether he had just succeeded or just failed. Arbitrary success and failure scores were given for the twelve equal items, and the performance on the next item was observed.

The analysis of time scores for these two procedures provided only mild support for the theoretical predictions. The low ability children showed pronounced trends in the opposite direction, that is, they speeded up in the presence of an audience and slowed down in the control situation. An attempt was made to refine the experimental hypotheses. Following the work of Sarason with test anxiety in children, varying numbers of "anxiety increments" were assigned to the sub-groups of children according to their characteristics, such as sex and ability, as these interact with aspects of the experimental situation, such as success and audience treatment. Reexamination of the data indicated that anxiety increments up to some optimum level appear to produce an effective, task-oriented decision performance; anxiety levels above or below the optimum lead to long decision times with no improvement in accuracy or to very short decision times which probably represent escape from the test situation. Microfilm \$2.00; Xerox \$4.80. 93 pages.

## THE EFFECTS OF STYLE OF LEADERSHIP AND INCENTIVES UPON THE INDUCEMENT OF AN ATTITUDE CHANGE

(Publication No. 21,764)

David Kipnis, Ph.D.  
New York University, 1957

Adviser: Dr. I. Chein

The purpose of this study was to determine whether a participatory style of leadership was more effective than a lecture style of leadership in inducing an attitude change when the leader explicitly offered to reward compliance or threatened to punish non-compliance.

The study design required a leader, under six experimental conditions, to attempt to convince subjects of a point of view which most or all of them were initially reluctant to accept. One week prior to the experimental portion of the study, subjects' opinions were measured and one week after the experiment, a second measure of opinions was obtained. These two measures of opinion were thought, by subjects, to be independent of the experimental discussion. Accordingly, changes in opinion from the first to second measurement were taken to reflect changes in private beliefs which could be attributed to the experimental conditions.

Six experimental conditions were established as follows: two conditions in which the leader promised to reward subjects complying with his induction attempt; two conditions in which the leader threatened to punish subjects not complying; and two control conditions in which no sanctions were associated with the leader. At each incentive level, the leader adopted a participatory style of leadership for the first condition and a lecture style of leadership for the second condition.

The subjects in this study were boys and girls in the 5th and 6th grades of a public school in New York City. Groups averaging six subjects met with the experimenter during the study proper. To establish the reward conditions, the leader offered prizes of movie tickets to those who complied with his induction attempt. To establish the punishment conditions, the leader initially promised all subjects movie passes and then threatened to deprive some subjects of these passes if they did not comply. Following these announcements, the leader conducted a meeting either using a participatory or a lecture style of leadership.

The results were as follows:

1) Participatory leadership induced significantly more changes in beliefs than lecture leadership when the leader was associated with neutral power or power to reward. However, when the leader threatened to punish non-compliance, lecture style leadership produced somewhat more change in beliefs than participatory leadership.

2) Subjects under participatory leadership expressed greater liking for the leader than subjects under lecture leadership when the leader was associated with neutral power or power to reward. When the leader threatened to punish non-compliance, no differences in evaluation of the leader were found between participatory and lecture conditions. In both cases the leader was rated low.

3) The lecture-punishment condition induced the greatest degree of public compliance and the second greatest degree of actual changes in opinions.

An overall conclusion of the study is that under



conditions of participatory leadership the group mediates between the leader's power and the individual group member. The superiority of participatory leadership over lecture leadership will be maintained as long as group members do not perceive the leader as backing his induction attempts with threats of punishment. The perception of such threats apparently serves to reinforce original group standards. Personal liking for the leader is felt to be, in part, negatively related to the degree subjects perceive the leader exerting pressure upon them to change. The success of participatory leadership (under conditions of reward and control) in engendering greater liking for the leader is attributed to its ability to create an illusion that little pressure is being exerted upon the subjects. Changes under threat of punishment are interpreted in terms of anxiety reducing behavior.

Microfilm \$2.00; Xerox \$4.60. 87 pages. Mic 58-5235.

**GROUP COMPOSITION, COMMUNICATION, AND  
CONSENSUS: AN INVESTIGATION ACCORDING TO  
NEWCOMB'S THEORY OF COMMUNICATION**

(L. C. Card No. Mic 59-800)

Albert John Lott, Ph.D.  
University of Colorado, 1958

Supervisor: Assistant Professor William A. Scott

This study investigated the effects of group composition on communication, interpersonal attraction, and consensus in four-person experimental groups. Following the communication theory of Theodore M. Newcomb, the study varied both perceived and objective similarity among the group members. These factors were varied to ascertain how they affected the communication process and how the communication process in turn affected them. Questionnaires measuring interpersonal attraction, perceived agreement, and objective agreement among the group members were administered before and after a thirty-minute period of free discussion. The amount of communication which took place during the discussion was tabulated by an external observer.

Eighty college students were placed in four-person experimental groups on the basis of their scores on the Allport-Vernon Study of Values. Ten of the groups were composed of four individuals with high economic values and ten groups were composed of two individuals with high aesthetic values and two individuals with high economic values. Within each of these types of group composition, half of the groups were told by the experimenter that they were highly similar with respect to their values and the other half were told that they were highly dissimilar. Thus both objective similarity (group composition) and perceived similarity (experimental set) were varied. All the groups engaged in a thirty-minute discussion of a problem related to economic and aesthetic values.

It was found that the perception of similarity did not lead to greater amounts of positive interpersonal attraction or a greater frequency of communication, as was predicted by Newcomb. However, objective dissimilarity led to greater increases in the rate of communication between the first two ten-minute subperiods of the discussion than

did objective similarity. This finding was contrary to Newcomb's prediction. The increase did not persist during the second and third subperiods of the discussion. These findings were interpreted separately in terms of Festinger's theory of communication.

The posttest results indicated no significant differences among the conditions with respect to perceived similarity or interpersonal attraction. However, those groups communicating under conditions of perceived dissimilarity achieved a higher degree of objective similarity at the end of the discussion. *Post hoc* hypotheses were advanced to explain why these individuals did not perceive themselves as similar as they actually were.

On the basis of these findings some weaknesses in Newcomb's theory were pointed out, along with suggestions for clarification. Possible empirical studies that would test certain aspects of both Newcomb's and Festinger's formulations of the communication process were indicated.

Microfilm \$2.00; Xerox \$5.20. 103 pages.

**INTERGROUP INTERACTION:  
A LABORATORY STUDY OF SMALL GROUPS**

(L. C. Card No. Mic 59-870)

Henry Lee Manheim, Ph.D.  
University of Southern California, 1958

Chairman: Professor H. J. Locke

The problem consisted of a laboratory investigation of interaction between small groups and tested the following four hypotheses. (1) The characteristics of interaction between two groups are related to the characteristics of the groups. More specifically, if groups of varying characteristics interact with one another in a standardized intergroup interaction situation (or a series of these), patterns of interaction will result which are related to the characteristics of the groups. (2) The larger the amount of intergroup interaction, the more positive (friendly) will be the relation between the groups; and, conversely, the smaller the amount of intergroup interaction, the more negative (hostile, unfriendly) will be the intergroup relations. (3) The greater the differentiation of groups, the greater are the probabilities of intergroup conflict. (4) If two groups, which differ from each other in a significant characteristic, have negative (hostile, unfriendly) relations with each other, these negative relations will tend to be expressed in terms of this differentiating characteristic.

The following design was utilized to test these hypotheses. Sixteen triads were formed from paid, college student subjects. The groups differed along two variables: relative status (I.Q.) and type of leadership (emergent or appointed). Each group was either a high- or low-status group and, also, had either an emergent or an appointed leader. The possible combinations of these two variables thus yielded four types of groups. Each group then interacted with another group in four discussion-task situations, interacting with a different one of each of the four types of groups, in each different situation. The interaction in each situation was restricted to written notes sent back and forth between the two groups. These series of notes, comprising the complete records of the interaction, were



analyzed by means of Bales' technique of interaction process analysis. In the statistical analyses, the 5 per cent level of significance was specified.

Generalizations from the results are limited by three factors: the nature of the subjects and groups, the task characteristics of the interaction situations, and the restrictions on the interaction.

The results supported the first hypothesis. Unique patterns of interaction were found which were shown to be related to the status and leadership characteristics of the interacting groups.

Statistical tests of the second hypothesis led to its rejection. On the contrary, the data indicated that the amount of intergroup interaction increases with increasing hostility of the interaction, although this was not a statistically significant relationship.

The third hypothesis was accepted. Interactions between pairs of groups which differed in both status and leadership showed nearly twice as much hostility as interactions between pairs of groups differing on only one of these variables; the latter, in turn, exceeded the interactions between pairs of groups with no differences, by approximately the same ratio.

The data were insufficient in quantity to test the fourth hypothesis adequately, although the results tended in the direction of the hypothesis.

The methodology of the experiment yielded some general conclusions, in addition to those derived from testing the specific hypotheses. Bales' technique was shown to be useful for measuring intergroup interaction, as well as intragroup interaction. This implies that these two forms of interaction are, at least, similar.

Small groups can be conceived of as actors, although Bales uses the term to refer to individuals. This lends support to the view that groups have real existence, *sui generis*.

Written communications are a valid and satisfactory medium for studying intergroup interaction. The application of these techniques to the study of written correspondence between groups holds promise.

Perceived differences are effective as a means of introducing experimental variables. These kinds of differences affect the patterns of interaction between groups.

Microfilm \$3.20; Xerox \$10.80. 245 pages.

#### SOME COGNITIVE FACTORS AFFECTING COMMUNICATION

(L. C. Card No. Mic 59-977)

Harry Charalambos Triandis, Ph.D.  
Cornell University, 1958

The dissertation begins with an exposition of a theoretical scheme describing the thinking process, in which categorization is the key element. The scheme is extended to a two-person situation. Operations for the measurement of three types of cognitive similarity are suggested. (1) Categoric similarity -- the members of the pair categorize concepts in similar ways; (2) Syndetic similarity -- the members of the pair relate their categories to other concepts in similar ways; (3) Symbaditic similarity -- the members of the pair relate their categories to each other

in similar ways. It is expected that pairs who are high on any one of these kinds of cognitive similarity will communicate more effectively than pairs of persons who do not have these characteristics. The more effectively two people communicate, the more they will like each other.

The Repertory Test, from G.A. Kelly's Psychology of Personal Constructs, is used to obtain a list of categories from two individuals, A and B. If A's and B's categories are similar we infer that their categoric similarity is high. The semantic differential, from C.E. Osgood's The Measurement of Meaning, is used to obtain measures of syndetic similarity. Both instruments were specially adapted for the purposes of this research.

The theoretical notions presented in the early parts of the dissertation were tested in an experiment and a field study.

In the experiment 40 students formed 20 pairs. The categoric similarity of each pair was measured by a comparative content analysis of the categories given as responses to the Kelly test, with pictures of emotional expression substituting for Kelly's "significant people". Each pair played six games. In each game the Ss sent written messages to each other about the two pictures that they held in front of them. All pictures were of the same girl posing different expressions. Each S had two pictures. One of the pictures held by A was the same as one of the pictures held by B. The task was to determine which picture they held in common. Communication effectiveness was measured by success in finding the common picture. The relationship between categoric similarity and outcome scores was positive, curvilinear and highly significant.

In the field study 177 employees of an industrial concern took a number of tests and answered a series of questionnaires. The categoric and syndetic similarity of supervisor-subordinate pairs was determined. Two concept domains were used -- jobs and people. The communication effectiveness and liking for the supervisor were measured by means of Thurstone successive intervals scales administered to subordinates. Analyses of variance determined that categoric similarity in the people domain and syndetic similarity in the job domain were significantly related to both communication effectiveness and liking for the supervisor. A three way analysis of variance with two levels of categoric similarity, two levels of syndetic similarity, and 16 supervisors, showed that syndetic similarity about jobs accounts for 71 per cent of the variance of liking-for-supervisor scores. A factor analysis and the computation of regression equations both suggest that syndetic similarity about jobs and categoric similarity about people are the best predictors of communication effectiveness and liking for the supervisor.

The methodological contribution of the dissertation consists of the development of procedures that permit the use of Kelly's and Osgood's techniques in industrial settings. Among the interesting by-products of these developments are lists of categories, about people and jobs, used by various groups in industry. These lists show that there are clear differences in the way managers, clerks and workers categorize people and jobs. Osgood's technique is also used to (a) establish profiles for the "ideal manager" and the "ideal workmate", (b) for the study of differences in the perception of mbs by different groups, and (c) by considering the profile difference between the actual and



the ideal supervisor of a given employee, for the measurement of the attitude towards the supervisor.

Microfilm \$4.00; Xerox \$13.40. 310 pages.

# REVERENCE GROUPS AND RECOVERY FROM MENTAL ILLNESS

(L. C. Card No. Mic 59-622)

Charles Dewey Whatley, Jr., Ph.D.  
Tulane University, 1958

Chairman: Thomas Ktsanes

This research is a social psychological study of prognosis of a group of recovered mental patients diagnosed with functional disorders. The study attempts to determine whether social factors which are believed to precipitate mental disorders may also prolong these disorders. Mead's theory of the self is used as a conceptual framework. The self is treated as being partially determined by social relationships with other persons. Thus, interpersonal alienation may become internalized and act as a source of continuing behavior pathology. The major hypothesis of the study is that patients who are severely alienated from their reference groups will have poor prognosis as defined by long periods of hospitalization.

Intensive interviewing of 96 recovered patients provided the basic data for measuring alienation from four reference groups: family, work group, neighbors and church companions. Two types of measures were used: the F-scores which measure frequency of self-other re-

actions to each of the four groups, and the Q-scores which measure alienation from them. Test-retest reliability of these measures is .77 (p .01).

Correlations of the F-scores with length of hospitalization reveal that frequency of self-other reactions to reference groups is unrelated to prognosis. The Q-scores, by contrast, show that the greater the amount of alienation from each reference group, the poorer the prognosis. The correlations for church, family, work and neighbors are respectively: .42, .29, .36, and .37 (p .01). The multiple correlation of all groups and length of hospitalization is .513 (p .01). The Q-scores also predict a composite index of prognosis (previous commitment and length of hospitalization). The multiple is .56 (p .01).

A series of single classification analyses of variance was computed for a group of status variables: age, sex, occupation, religion, marital status, education and race. Excepting marital status, none of these variables is significantly associated with length of hospitalization. They are poor predictors of prognosis. Being married correlates .32 with good prognosis.

Three conclusions of this research are: first, factors in the social environment which contribute to the causation of mental disorders may also prolong these disorders. Second, patients continue to be affected by social relationships previously experienced by them in various social groups. This finding points up a factor in prognosis which has not been assessed by students who believe the social environment of the hospital is the main determinant of a patient's eventual recovery. Finally, social status variables appear to be poor predictors of prognosis as compared with the more direct assessment of social factors using the reference group approach.

Microfilm \$2.15; Xerox \$7.60. 164 pages.

## SOCIOLOGY

### SOCIOLOGY, GENERAL

#### AN ANALYSIS OF THE "PERSONAL" AND "INSTITUTIONAL" VALUES OF A MODERN MIDWESTERN COMMUNITY

(L. C. Card No. Mic 59-791)

Samuel John Dackawich, Ph.D.  
University of Colorado, 1958

Supervisor: Assistant Professor Judson B. Pearson

The central problem of this research was to test the utility of the sacred-secular theory of values presented by Talcott Parsons and Howard Becker. According to these theorists, the population of a modern city of the United States ought to have a predominantly secular values system. Parsons' "ideal-type" societal structure composed of secular values is termed "universalistic-achievement." Becker's corresponding "ideal-type" is referred to as the "principal."

A value was defined as an element of a shared symbolic

system which serves as a criterion or standard of selection among behavior alternatives intrinsically open in a social situation.

A survey was conducted to determine the values of a representative sample of the population of Boulder, Colorado. Responses to open-ended interview questions about what the respondents liked and disliked about people were termed "personal values." The respondents' ratings of pre-tested items representing activities and statuses of the family, the political, the economic, the religious, and the educational institutions were termed "institutional values."

It was hypothesized that, in addition to the values for the community as a whole exhibiting secular characteristics, there would be important differences from one set of roles to another. Role differences in values were analyzed upon the bases of occupation, education, and sex for the "personal values." Additional analyses upon the bases of age and religious affiliation were made for the "institutional values." The number of achievement-oriented, instrumental "personal values" expressed were in a distinct minority, contrasted to the expressive, "moralistic" type



of "personal values." However, most of those expressed qualified as universalistic-achievement values by virtue of their universality of application; only three of the "personal values" were of the more sacred, particularistic type. The "institutional values" were also classified as universalistic-achievement or non-universalistic-achievement. In general, the difference found between roles were as expected, the more sacred values being expressed by those in the lower occupational and educational groups, by females, by the older age group, and by those with the more sectarian religious affiliations.

Microfilm \$2.45; Xerox \$8.60. 188 pages.

UNITED STATES SENATORS:  
A SOCIOLOGICAL AND HISTORICAL STUDY  
OF A POLITICAL ELITE

(L. C. Card No. Mic 59-794)

Rodney Duanne Elliott, Ph.D.  
University of Colorado, 1958

Supervisor: Associate Professor Edward L. Rose

The personnel of political bodies have seldom been of the same social backgrounds as the general population they represent or control. While formal processes usually exist for the selection of such personnel, informal selection of persons with specific social characteristics usually operates to eliminate the vast majority of the population from consideration in the formal selection process. A number of studies have been made of the social backgrounds of executive cabinet members, justices, and legislators in various countries and in various states. These studies have shown that political elites have generally been selected from aristocratic and upper class groups. In order to ascertain some of the social characteristics favorable to selection for the United States Senate, a large number of items concerning the educational attainments, military experience, occupations, and political careers of U. S. Senators were collected on all 1541 persons entering the Senate from 1789 to 1956. Frequencies for each category of information were tabulated and percentages computed for each of fourteen 12-year periods in American constitutional history. This study differed from previous studies in that (1) it included the entire population of the elite body in all periods of history, which permitted definite statements about the body and facilitated the discovery of historical trends, (2) it tested a series of previously formulated hypotheses relating to elite formation in different stages of history, and/or (3) it collected and analyzed political career data previously neglected by most other studies.

A majority of United States Senators entering throughout American history were lawyers. Businessmen began entering the Senate following the Civil War and have been an important bloc ever since. Significant numbers of farmers were seated in only the first few Senates. After 1945 numerous professionals such as journalists and teachers entered the Senate. Senators have always been better educated than the general population and the percentage of college-trained Senators has consistently increased. The military experience of Senators was gen-

erally correlated positively with the incidence of large-scale wars, but high ranking officers failed to enter the Senate after both World Wars as they had after the Revolutionary and Civil Wars. In general, recent Senators were much older and had more legal, occupational, and political experience than Senators seated prior to the Civil War, but this general trend was halted, if not reversed, after 1933. Recent Senators usually served in state executives, local and state judiciary systems, or the U. S. House of Representatives prior to their Senate entry, but earlier Senators served in the state legislatures rather than in the state executives.

A hypothesis that elites were selected from businessmen and lawyers as a result of industrialization was only partially supported by this study and a hypothesis that recent international crises were accompanied by elites of specialists in persuasion and specialists in violence was not supported by data on U. S. Senators. Comparisons of Senators affiliated with different political parties revealed concentrations of businessmen in the Republican Party and lawyers in the Democratic Party. Regional comparisons reflected the one-party systems of the South and the East and the concentration of businessmen in the East.

Analysis of the rates of change in various social characteristics of U. S. Senators revealed that three periods in American history were accompanied by great changes in Senate composition. The 1801-1812 period and the recent 1945-1956 period were accompanied by several significant changes in the occupational and educational backgrounds of Senators while the 1873-1884 period was accompanied by several changes in the length and type of pre-Senate political careers.

Microfilm \$2.50; Xerox \$8.60. 189 pages.

RURAL RESIDENT COMMUNITY IDENTIFICATION  
AND COMMUNITY CHANGE OVER A TEN-YEAR  
PERIOD: A STUDY OF A SOUTH CENTRAL  
NEW YORK RURAL COMMUNITY, 1947 AND 1957

(L. C. Card No. Mic 59-679)

William Abram Foster Jr., Ph.D.  
Cornell University, 1958

This study was concerned with the assimilation of rural residents in the Odessa community, Schuyler County, New York, analyzed in the context of community change from 1947 to 1957. It was a phase of the community studies conducted by the Department of Rural Sociology, Cornell University. This study dealt with shifts in the population of the Odessa community, comparison of characteristics of farm, village and rural residents, and differential changes in community identification among population types over the ten-year period.

Data, obtained by means of surveys of the Odessa community in the summers of 1947 and 1957, included a complete enumeration for selected population characteristics and a 50 per cent sample for identification and participation information. Hence statistical tests of significance were not used for generalizations about the Odessa community. Rural respondents, as used in this study, were defined as members of nonfarm households residing outside the village. Farm residents were members of



households whose head gained more than half his cash income from farming.

The descriptive analysis of community change provided the setting for the study of assimilation of recent rural residents. Assimilation was measured by intensity of community identification, defined as the degree of feeling a part of the Odessa community as expressed by male heads and homemakers.

The total population of the Odessa community increased 18 per cent over the ten-year period. Rural residents increased from 61 to 70 per cent, village residents from 18 to 19 per cent, and farm residents decreased from 21 to 10 per cent of the total community population. The bulk of the increase in the rural resident population was in the open-country nonfarm component, resulting mainly from in-migration.

In 1957, rural residents ranked lower than village or farm residents in the following characteristics: length of residence in the community, trading within the community, participation in community-based organizations, and identification with the Odessa community. Rural residents were more heterogeneous with regard to these characteristics than were village or farm residents. When the rural resident category was divided into its components--open-country nonfarm residents, minor-occupation farm residents, and hamlet residents--the variability of the above characteristics was appreciably reduced.

Length of residence and level of living each were positively associated with intensity of community identification. Participation in community-based organizations was the single factor most highly associated with community identification. Long length of residence and high level of living increased the positive association of participation in community-based organizations with community identification.

The following hypotheses were not confirmed: that the intensity of community identification would be greater for those recent rural residents who had moved a greater distance, or who were from a rural or suburban rather than an urban place of residence, or whose household head in 1957 worked a greater distance away from his former residence.

Working and trading within the community decreased over the ten-year period. There was also a decrease in feeling a part of the Odessa community. However, the proportion of respondents naming Odessa as their community did not decrease markedly. The influx of open-country nonfarm residents posed problems for maintaining or increasing community solidarity. The strong association of participation in community-based organizations with community identification found in this study suggests that leaders should encourage community-wide projects to enlist the participation of newcomers if they are to identify strongly with the community.

Microfilm \$2.15; Xerox \$7.60. 163 pages.

# BEHAVIORAL CONFORMITY TO CHURCH TEACHING AS A FUNCTION OF THE SENTIMENTS OF THE INDIVIDUAL AND MEMBERSHIP GROUP IDENTIFICATION

(L. C. Card No. Mic 59-693)

John Democritos Photiadis, Ph.D.  
Cornell University, 1958

This study explores two causes of behavioral conformity to the teaching of the Mormon church, the individual's religious beliefs and values, and his church participation. The data were collected in a semi-rural community in Utah from 553 male church members.

Functionalists as Durkheim and Malinowski have discussed the mutual dependence of religious beliefs, values, and ritual. They refer to ritual as a conditioning factor reinforcing the sentiments of the individual. The attributes which define behavioral conformity in this study are not rituals *per se*; however their function is similar to that of a ritual. The present data actually show that religious belief and ritualistic behavior, or in this case behavioral conformity to church teaching, are highly related. However, when this relationship was tested with church participation, the relationship under high church participation in some cases disappeared and in some reduced. In other words, those who were high participants conformed about the same concerning overt behavior, but differently concerning covert behavior; the dependence of religious belief and ritualistic behavior which Durkheim and Malinowski have mentioned is not always mutual, at least in complex societies.

For further demonstration of the influence of the group on the individual's behavioral conformity, regardless of his religious belief, it has been shown that the more emphasis is placed on the church group norms by the various subgroups in the church, the greater is the increase of difference between overt and covert conformity to these norms.

It was further assumed that if conformity to the membership groups norms was the cause of this phenomenon, participation in groups with different norms, such as secular organizations, would not cause this phenomenon. Actually, the data show that the relationship between behavioral conformity and religious belief is not affected by secular participation.

When behavioral conformity was separately correlated with church participation, a highly significant relationship was found. When religious belief was introduced as a test variable, both religious belief and church participation independently and cumulatively influence behavioral conformity to church teaching. However, religious belief as a test variable only moderately influenced the relationship between church participation and behavioral conformity under high belief, whereas, the relationship between behavioral conformity and belief almost disappeared when high church participation was used as a test variable.

When religious belief and church participation were compared as to their total influence as test variables, the influence of the latter was stronger. To increase the reliability of the measure of association which was used in this study, participation, whether church or secular was used for all relationships under three forms; "participation in church activities", "total offices held", and "church participation score". The last is a modified form of the



Chapin scale. When the two test variables were compared as to their influence on the corresponding relationships, twelve pairs of Phi coefficients were used. In all twelve cases church participation appeared stronger than religious belief.

The individual's perception of his religious belief and his church participation as compared to that of others in the community was more highly related to behavioral conformity, than actual religious belief and church participation. Perception of secular participation as compared to that of others in the community was negatively related to behavioral conformity, although actual secular participation was positively or not related to behavioral conformity. The latter was thought to be due to interaction in the larger group, the community (through secular participation) which has norms similar to those of the church.

High behavioral conformists were more likely to hold those values most emphasized by the church. The values emphasized by the community were second and the values of a non-Mormon community of the American society where the same value categories were used, were third. Rank correlation coefficients were used to identify the position of each of the three groups.

The seven variables which were used in this study besides participation (where the Chapin scale was used), met the test for unidimensionality with the use of the Guttman technique. Microfilm \$2.40; Xerox \$8.40. 183 pages.

#### PERSISTENCE OF CASTE IN SOUTH INDIA - AN ANALYTICAL STUDY OF THE HINDU AND CHRISTIAN NADARS

(L. C. Card No. Mic 58-2818)

Hilda Raj, Ph.D.

The American University, 1958

The problem posed in this thesis is the persistence of caste in the descendants of Nadar families which were converted to Christianity in the first part of the nineteenth century by Protestant missionaries from England. The objectives of the research are firstly to see what aspects of caste exist in the Christian group, to justify calling the group a sub-caste of the Nadar caste. Secondly, to explain the persistence of caste features by analyzing the social structure and culture of the Christian sub-caste.

Data for the thesis were collected by library studies in India and in Washington, and by field-work in South India. Firsthand information was available to the writer as a participant observer. A certain amount of life-history material obtained through questionnaire forms and autobiographies has been used to illustrate the culture of the Nadars.

Caste in India is presented as a social system with cultural accumulation. Recent studies on the subject reveal the transformations that are taking place due to social mobility, education, industrialization and the policy of the Indian Government. The study is then directed to the Nadar caste in its habitat, which is Tinnevely District, to its economic and social developments and its culture. The history of the Protestant Christian group is traced from the time of the first converts to the present.

By means of a theoretical model devised for the pur-

pose, the two segments of the Nadar caste are analyzed with respect to their social structure and culture. In spite of cultural modifications brought about by conversion, the Christian group is seen to have a culture which in some significant aspects is identical with that of the Hindu group. It is concluded, therefore, that the Christian Nadar is a sub-caste of the Nadar caste. The core of the Nadar caste which is common to both the segments has been preserved by a social structure in which the bonds of kinship are continuously renewed through the practice of caste endogamy.

The persistence of caste in the Christian group is explained in terms of the need of the early converts for the continuity of group-life of the type familiar to them within the caste, and in terms of the values that the culture of the caste has had for their descendants for the last hundred years or so. The continuity of group-life within the caste pattern was never lost, for usually a family or a number of families at a time became converted to Christianity. The increasing numbers (over 58,000) by 1869 made for social solidarity and the conserving of the familiar culture.

The final argument is that caste persists in the Christian Nadar group because the cultural milieu of caste provides not only designs for living, but also generates values for the individual who lives within the caste. The culture of the Nadar Christian is imbedded in a social system called caste, and the cultural values contribute to the continuity of that social system.

Microfilm \$3.65; Xerox \$12.40. 281 pages.

#### THE ROLE OF WOMEN IN INDIAN PUBLIC LIFE IN MODERN TIMES

(L. C. Card No. Mic 58-2819)

Anima Sen Gupta, Ph.D.

The American University, 1958

This study undertakes a sociological analysis of Indian society to better understand the role of women in Indian public life. It is undertaken with a belief that some of the prevalent misconceptions, both at home and abroad, about Indian women, are the outcome of the failure to understand the total social system within which women participate. More specifically, this study attempts to find out whether there has been an increased participation of women in Indian public life.

The trends of participation of women in different phases of Indian life, such as in education, politics and in the labor force are pointed out. An endeavor is made to relate trends of participation of women in Indian public life to the more fundamental changes of Indian social structure.

The outstanding fact about India in recent years is its reawakening stimulated by contact with the West but fed by the deep spiritual and cultural resources of its people. Women have been one of the major benefactors of and participants in this renaissance which came to full bloom since independence.

A detailed analysis has been made of women's role in six major institutions within the Indian social system. Women's role within the family is a private one rather than public, but it is such an important phase of their activity that it colors the rest. The traditional large joint family is becoming more and more uncommon and is being



replaced by small joint families. Under the impact of industrialization, urbanization, and the concept of individual freedom this age-long institution has been experiencing certain shifts in its structure. Women as members of small families will have less family obligations to discharge than before.

While the informal role of women in religion has always been great, India's womanhood does not play an important part in public religious activities. There does not seem to be any indication of a movement for greater formal participation.

Women have long played an important role in the economic life of India. However, available statistical data show that today women form a smaller part of the labor force than they did twenty years ago. Apparently this fall is due mainly to the unemployment situation and the prevailing attitudes in regard to it. There are some encouraging exceptions, however, in education, and government employment.

Educational leadership for Indian womanhood holds out great hopes - rates of illiteracy are coming down. This influences labor force participation and all phases of women's status.

Indian womanhood despite its recent enfranchisement and the extent of illiteracy stands with the most advanced nations of the world in regard to the participation of women in politics. Circumstances are partly responsible. Women's rights and struggle for independence are closely linked.

Women's organizations provide apprenticeship in politics, help in removing disadvantages of women on non-sectarian basis and also provide nationwide work for unity of Indian womanhood and increased participation of the lower classes in all phases of public life.

Stimulated by contacts with the West, active in the movement for independence, trained by long tradition to participate in economic, political and educational undertakings, India's womanhood is ready to meet the new demands that independence has imposed.

Microfilm \$5.45; Xerox \$19.20. 426 pages.

#### SOME EFFECTS OF SIZE OF SHARE IN TASK ON MOTIVATION IN WORK GROUPS

(L. C. Card No. Mic 59-606)

David M. Shaw, Ph.D.  
University of Minnesota, 1958

Adviser: Henry W. Riecken

A laboratory experiment was conducted which explored the following hypotheses: (1) the larger the share an individual has in activities leading to a group product, the greater his motivation to work hard for a quality product; (2) the more identifiable an individual's work is in the final product, the greater the motivation to work hard for a quality product; (3) individuals with a high need for recognition have greater motivation than individuals with low need for recognition when their work is identifiable and they have a large share in the product; (4) individuals with high need for achievement are motivated to work regardless of opportunity for identification and size of share of product activities.

Size of share and identifiability are related to motivation in the following way: as the size of one's share in a task becomes large, rewards (positive evaluations of the product) increase; as the opportunity to identify one's own work increases, the opportunity for positive evaluations of the product to be rewarding increases.

The experiment was conducted with female college students. Size of share in the task was varied by forming small groups of size 2 to 5 (large share) and large groups of 6 to 8 (small share). In each experimental group, subjects were told they would engage in a cooperative-studying task. Each subject would be allowed to choose one among several articles describing stellar constellations and would abstract the article. All subjects would exchange abstracts and study them for a test on all material abstracted by members of that group. In all groups, the group score on the test served as the product of group activity. Identifiability was manipulated by instruction: in the identifiability condition, subjects were told that a group score on each section of the test (i.e. on the material contained in each article) would be reported separately; in the non-identifiability condition, only a single group score on all sections combined would be reported. Subject motivation to work for a quality product was measured by allowing the subjects to choose among articles of varying lengths from which to make the abstract. The instructions stressed the relationship between the length of article, quality of abstract, and quality of final score. By choosing a long article, a subject presumably indicated a high motivation to achieve a quality product. When subjects had indicated their choice, they completed an experimental questionnaire after which the experiment was over; thus, the task was described but never actually begun by the subjects. An instrument measuring need for achievement and need for recognition was administered prior to and independently of the experiment.

The major findings were:

1. Hypothesis 1 was verified. Subjects in the large share condition chose significantly longer articles to work on than subjects in the small share condition.

2. Hypothesis 2 was disconfirmed. While holding size of share constant, it was found that subjects in the large share, non-identifiable condition chose longer articles than subjects in the identifiable condition. In the small share conditions, subjects in the identifiability condition chose longer articles. These differences were not significant. Questionnaire evidence indicated that the identifiability instructions were probably producing a weak effect.

3. Hypothesis 3 was partially confirmed. The relationship between need for recognition and length was positive for the large share conditions and negative for the small share conditions. Within the large share conditions, the relationship for the non-identifiable groups was larger than for the identifiability groups. The negative relationship in the small share groups was explained in terms of lack of willingness of subjects with high need for recognition to work hard when there is little opportunity for positive evaluation.

4. Hypothesis 4 disconfirmed. Need for achievement was not related to motivation under any of the experimental conditions. Microfilm \$2.00; Xerox \$5.40. 109 pages.



# THE LEGAL AND SOCIAL STRUCTURES OF SLAVERY IN THE UNITED STATES

(L. C. Card No. Mic 59-577)

Arnold Anthony Sio, Ph.D.  
University of Illinois, 1958

The content, organization, and aim of this study have been guided by an interest in initiating as well as in testing a theory and conception of slavery. With respect to the first, the emphasis is on those aspects which appear as problematic or neglected in well-known historical studies of ante-bellum slavery. As to the second, the emphasis is on the widely prevailing interpretation of slavery which involves the legal definition of the institution in terms of property. The primary aim of this initial venture and part-study in the sociology of slavery is to reformulate, re-focus, and clarify the existing interpretations and conceptions of slavery in the ante-bellum South.

While the practice among slaveholding peoples of defining the institution in terms of the category of property appears to provide the support of legal form to the study of slavery mainly in economic terms, the evidence for the social structure of slavery from nonliterate and ancient society reveals two contrasting patterns of the master-slave relationship, only one of which is compatible with the rational use of slaves as economic instruments. This suggests that despite the formal similarities of legal definition, given the practice of taking outsiders into a society for use in economic production and legally defining them in terms of the category of property, the outcome may be very different between as well as within slave-holding societies according to the structure and value system of the enslaving group.

The legal definition of the slave in the ante-bellum South was informed by caste and ethical as well as economic values. This ambivalence in the valuation of the slave was significant for the institutionalization of the system. Instead of a single pattern of the master-slave relationship involving the rational use of slaves as economic instruments, there were two patterns, rational and traditional. The first was compatible with the rational employment and administration of slaves whereas in the second the valuation of the individual modified the consequences of economic and caste values. The pattern of the relationship was not identical for all slaves. Those highest in the slave hierarchy participated in the traditional pattern, whereas those lowest were involved in the rational pattern. Status differentials and the pattern of the master-slave relationship were related in turn to the acculturation of the slave. Just as they were not uniformly related to the system, so the slaves were not equally identified with it. The mode of adaptation to the slave role was a function of the slave's conception of the legitimate or illegitimate character of the institutional arrangements of slavery. This was related to his rank in the hierarchy and the pattern of relations with the master.

The status of slavery in the ante-bellum South was intended to differentiate between sections of the population as distinct cultural and social entities in an hierarchal relationship. The interdependent conjuncture of the failure of the coextensiveness of the slave and caste components to become institutionalized for all persons of Negro ancestry, the absence of a correlation between caste, culture, and slavery, and the heterogeneous ethos of the dominant

group with reference to slavery functioned to prevent the system from providing a basis for the complete cultural and social differentiation of the slaves and masters along hierarchal lines. There is no locus within the system which can serve as the basis of a conception of ante-bellum slavery as a determinate, static, and completely institutionalized system.

Microfilm \$3.35; Xerox \$11.40. 258 pages.

# OCCUPATIONAL ASPIRATIONS OF NEGRO MALE HIGH SCHOOL STUDENTS IN NORTH CAROLINA

(L. C. Card No. Mic 59-432)

Odell Uzzell, Ph.D.  
The Ohio State University, 1958

## Purpose

The main purpose of this study was to investigate the occupational aspirations of a selected sample of urban senior high school youth in Eastern North Carolina and relate their expressed aspirations to significant social background characteristics. Other problems were (1) to identify the patterns of interoccupational mobility, if any; (2) to determine the relation between occupations to which the respondents aspire and those which they expect to enter; (3) to identify the difficulty, if any, respondents expect to encounter in entering aspired occupations; (4) to determine the sources of respondents' occupational aspirations.

## Major Hypotheses

1. Occupational aspiration level is related significantly and positively to the educational and occupational status of respondents' parents.
2. Aspiration and expectation levels differ significantly in relation to the educational status of respondents' parents.
3. The level of occupational aspiration is significantly related to success in school.
4. The occupational aspiration level is related significantly and positively to respondents' knowledge of "occupational models."

## Methods and Procedures

1. Questionnaires and interviews were used to obtain data from a proportionate random sample of 301 respondents in 14 schools.
2. The critical ratio test for significance was used.
3. Two categories were used to group respondents for analysis of occupational aspirations. First, respondents' occupational aspirations were ranked according to their North-Hatt prestige score, actual or interpolated. The upper and lower thirds were compared for relevant social background characteristics. Secondly, respondents were categorized by their aspirations as compared with their fathers' occupations. Those with aspiration scores higher than their fathers' occupations were designated "upward mobile;" those with aspiration scores the same as as fathers' occupations "non-mobile;" and those with aspiration scores lower than fathers' occupations "downward." Respondents within these three mobility levels were compared for relevant social background characteristics.



**Conclusions**

1. The relationship between the levels of aspiration and parents' educational status was significant at the .01 level, while that between the levels of aspiration and fathers' occupational status was not statistically significant.
2. Of the respondents with expected occupations, those who aspired highest also had expected occupations with higher scores than respondents who aspired lowest. Similarly, respondents who aspired highest had parents whose educational and occupational status was somewhat higher than parents of respondents who aspired lowest.
3. The relationship between the levels of aspiration and success in school was significant at the .01 level.
4. Of the respondents who knew models, 77 per cent indicated their choices were influenced by them.
5. Occupations involving the building trades, engineering, teaching, and commissioned service in the Armed Forces were most frequently mentioned and, hence, were conceptualized as "routes" of occupational mobility.
6. Lack of money and inadequate academic preparation were mentioned most frequently as difficulties respondents expected to encounter in entering preferred choices.

7. Occupational models had the greatest influence on choices with all groups except engineers, who indicated persons in other fields (notably teachers) and various forms of mass media. Parents were mentioned infrequently.

8. On the basis of academic grades, aspiring physicians, lawyers, and teachers appeared more realistic in their choices than did engineers.

**Implications**

1. The lack of a positive significant relationship between levels of aspirations and fathers' occupational status may be viewed against the normal patterns of Negro employment. More than normal numbers held occupations with low prestige scores.

2. Inasmuch as a positive relationship existed between levels of aspiration and parental educational status, it seems possible, if not likely, that parental "influence" may have taken the form of encouragement.

3. The extent of unrealism of aspiring engineers' choices may indicate the ineffectual role engineer models played and/or the current demand for engineers.

Microfilm \$2.00; Xerox \$6.60. 136 pages.

## SPEECH-THEATER

**BRITISH SPEAKERS IN AMERICA, 1900-1930**

(L. C. Card No. Mic 59-195)

Wilbur Howard Baisinger, Ph.D.  
Northwestern University, 1958

Supervisor: E. J. Wrage

During the years 1900-1930 more than 175 British visitors delivered addresses to American audiences on thousands of occasions. More than 700 separate speech texts were uncovered. This represents a significant increase over the amount of British speaking in America which, according to Wayne Minnick's unpublished doctoral dissertation, "British Speakers in America, 1866-1900" (Northwestern University, 1949) occurred between 1866-1900. The purpose of the present study is to survey British speaking in America from 1900-1930 as speaking events and to discover insights revealed into the political, social, and intellectual history of this time.

A survey was made of the speakers' backgrounds and of their incentives for speaking. Their speeches were classified according to broad themes (e.g., international relations, religion, education) and the principal lines of argument identified. Their ideas were interpreted with reference to the total setting in which they were presented. The role played by British speakers on the American lecture platform was considered, as were the speakers' rhetorical goals and methods. Contemporary attitudes toward the speakers and toward the American lecture platform were surveyed.

Significant changes were noted in the backgrounds of speakers who came after 1900 and in the ideas and issues

which engaged their attention. Increasing numbers were identified with social protest movements, and England's foremost representatives of Church and State came in substantial numbers. Many speakers were preoccupied with Anglo-American and international relations, and urged close cooperation and friendship between the two nations. Their virtual unanimity of view stemmed from consciousness of England's weakening international position in politics and trade. Other themes also engaged the speakers' attention, principally the criticism of modern life and manners, education, women's rights, spiritualism, religion, labor, and literature. Several of these themes reflect a conflict of older standards and values with the new.

Prominent Britishers often commanded massive public audiences. Moreover, numerous organizations, representative of American commercial, cultural and political interests frequently invited them to speak.

Most of the lecturers were advocates of propositions and ideas. Many of their views ran counter to prevailing American beliefs, but generally speaking, the Britishers attempted to identify American and British interests. They carefully avoided overt clash with American opinion. Most speakers were well received on the whole, although some were criticized for poor content and inept presentation. Some Britons and Americans joined in condemning commercial influences in lecturing and instances of incompetent speaking.

Available texts provide an index to political, social, and intellectual issues of the period and reveal a marked shift from the absorbing interests of nineteenth century speakers and audiences. The religion-science controversy subsided and Britishers became concerned with preserving



an "Anglo-American" peace. Another shift of topical interest was to urge the extension of democratic government in order to improve social conditions. Democratic idealism, however, was tempered by awareness that it was not a panacea for the world's ills.

American audiences tended to be middle class, conservative, and to react unfavorably to radicalism in any form. They continued to be sensitive to criticism, though less so than in the preceding century. A current of anglophobia persisted throughout the period, though it was less pronounced after the Irish settlement.

In the nineteenth century, Minnick reports, British speakers were agents in the transmission of culture to the relatively immature society of the new world. A similar role was performed by speakers who came between 1900-1930, though the ideas transmitted were more political (i.e. international politics) than cultural.

Microfilm \$5.25; Xerox \$18.60. 412 pages.

#### A COMPARATIVE TREATMENT OF FACT, INFERENCE AND CAUSATION IN THE THEORY OF ARGUMENTATION AND OF GENERAL SEMANTICS

(L. C. Card No. Mic 59-197)

Sanford Irving Berman, Ph.D.  
Northwestern University, 1958

Supervisor: Martin J. Maloney

A semantic analysis was made of the treatment of fact-inference in general semantics and fact-opinion in argumentation theory, "fact," "truth," Aristotelian and non-Aristotelian logic and causation.

The treatment of fact-inference in general semantics and fact-opinion in argumentation theory is similar. An important educational practice in argumentation theory, as in general semantics, is the differentiation between direct evidence and circumstantial evidence or between statements of fact and inference. The debate texts further indicate that most of the evidence is that of opinion.

Korzybski goes further, however, in his analysis of the neurological mechanisms involved in abstracting on different orders of abstractions and the general applications of consciousness of abstracting for proper evaluation.

The clear definition of the word "fact" is not only a first problem in philosophy but is equally important in rhetorical and argumentation theory. The assumption that we know what facts are is not only false but dangerously false. "Facts," like "truth," are not simple entities. They are ambiguous terms used continually in many different senses--usually unconsciously.

Facts are incomplete symbols. Korzybski, Schiller, Dewey, Einstein, James, Bridgman and others pointed out that just as time, length, energy, etc., are defined in terms of operations or method of approach, so the term fact is a "fact for" something, from some point of view, position, relative to a given dispute, or relative to two or more persons at a given time arguing about a particular issue. The multiordinality of the important terms "fact" and "truth" must be recognized as having no general meaning, i.e., devoid of meaning outside of a particular context.

The "truth theory" is a central notion in Rhetoric.

Most rhetoricians defined truth in terms of the "correspondence theory," i.e., a correspondence between the mind and reality. They recognized the difference between "material truth" and "logical truth." However, it is the use of "truth" in two different senses that creates confusion. In order to get around this difficulty Rapoport proposes the word "truth" to apply to material truth and "validity" to logical truth.

Logic has had many uses and meanings to philosophers. Traditionally, logic referred to the logic of Aristotle. More recently, modern or non-Aristotelian logics have been proposed, offering more general rules of reasoning than Aristotle's postulates. The three-valued and infinite-valued logics have been offered as extensions of Aristotle's two-valued logic of truth or falsity, to apply where Aristotelian logic is limited--such as in dealing with asylogistic thinking and relations.

Korzybski's system is not a non-Aristotelian "logic" but a "psycho-logics." It is concerned with how our thought-patterns are governed by the structure of the language we use and how our behavior is the inescapable consequence (logical fate) of the logic of our language.

Aristotle's four causes have been superseded by other analyses until scientists today rarely use the term cause and effect. Heisenberg's principle of indeterminacy constitutes the proof that the laws of probability (statistical regularity) take over the place once occupied by the law of causality. Korzybski states that cause and effect imply a two-term relation nowhere to be found in this world, thus representing a logic not appropriate to the structure of the world. He substitutes a functional formula, non-linear, non-additive and multi-valued analysis (general infinite-valued notion of causality) for the two-valued cause and effect.

Argumentation and debate textbooks might consider making a greater definition, clarification and consideration of "fact," "truth," non-Aristotelian logic, psycho-logics and the functional formula or infinite-valued notion of causality incorporated in the modern or non-Aristotelian logics and systems.

Microfilm \$4.15; Xerox \$14.00. 323 pages.

#### INVENTION IN THE LYMAN BEECHER LECTURES ON PREACHING: THE LECTURERS' ADVICE ON GATHERING AND SELECTING SERMON MATERIAL

(L. C. Card No. Mic 59-485)

William Ross Carmack, Jr., Ph.D.  
University of Illinois, 1958

During the 1871-1872 school term Henry Ward Beecher delivered the first series of Lyman Beecher Lectures on Preaching at Yale University. The lectureship comprises a valuable body of material on homiletics and related subjects by outstanding Protestant clergymen and laymen. This study attempts to show that the published Yale lectures delivered between 1871 and 1957, taken as a whole, yield a complete and harmonious description of the process of inventing material for sermons.

The lecturers divided invention into two groups, indirect and direct, or the preparation of the man himself and the preparation of the specific sermon. In discussing



indirect aspects of invention the lecturers called for certain personal characteristics, a thorough intellectual background, and a sympathetic understanding of humanity on the part of the minister. Turning to more direct aspects of invention, they discussed the minister's selection of a topic upon which to preach, the type of sermon best suited to his ends, a Biblical text upon which to base his sermon, and a clear aim. They showed the relationship of these aspects of invention to later phases of the process. Next, the speakers discussed gathering sermon material and suggested criteria to guide the preacher in selecting from all available material that portion best suited to his needs. The lecturers provided a broad classification of sermon materials. They differentiated between material appealing primarily to the emotions and primarily to the intellect, calling for both kinds in preaching. Beyond this, they recognized the value of appeals which arise from the speaker himself. In short, they took into account the three classical modes of support, logical, emotional, and ethical. Although they did not elaborate this broad classification, a few singled out humor as a possible emotional appeal and several dealt in some detail with illustrations as an example of appeal to the intellect. The lecturers emphasized the necessity of accommodating the entire sermon to the needs and level of a particular audience. Thus, their description of the process of invention was complete in discussing the major categories relevant to sermon preparation.

The lecturers' system of invention was harmonious, not because they always agreed in detail, but because they agreed on broad principles and their advice was more often complementary than contradictory. An appendix to this study presents in tabular form the lecturers who discussed the various topics considered in the thesis.

The lecturers were not uniform in contributing to this description of invention. Some devoted whole lectures to invention, while others said little. The first decade of the lectureship was the most productive period in treatment of invention. This decade included the lecturers of Henry Ward Beecher, John Hall, William Taylor, Phillips Brooks, R. W. Dale, Matthew Simpson, Howard Crosby, and E. G. Robinson. Later Nathaniel Burton, John Watson, John Kelman, Charles R. Brown, and Paul Scherer contributed substantially to the description of invention.

In concluding, this study points up emphases of the lectures that correspond to, and differ from, the teaching of secular rhetoricians.

Microfilm \$2.35; Xerox \$8.20. 180 pages.

ON PRODUCING RACINE'S TRAGEDIES;  
WITH PARTICULAR REFERENCE TO  
PRODUCTION IN ENGLISH

(L. C. Card No. Mic 59-202)

Rowland Kimball Chase, Ph.D.  
Northwestern University, 1958

Supervisor: Lee Mitchell

This study has been undertaken with the objective of analyzing the relationship of Racine's structural techniques to the problem of producing his tragedies, with particular

reference to production in English. The study recognizes that Racine's drama is not performed extensively in our theatre and it assumes that at least part of the reason for this neglect is unfamiliarity with the demands of Racinian style. Racinian performance must be based on an exceptional emotional response which needs to be communicated convincingly but which must at the same time be regularized and formalized in a way that is generally unfamiliar to our English-speaking actors.

In order to understand the connection between the emotional base of the action and the restriction imposed by the form, the director needs to make a close study of the structure of the play he is producing. This analysis will be useful for two reasons. (1) Since structural compression contributes greatly to the emotional force of the drama, the director must know how this compression is achieved if he is to realize the greatest possible impact from his production. (2) The meaning of the drama is most clearly revealed when the audience can be encouraged to perceive the action "transparently" on two levels simultaneously. The audience should, moreover, be induced to respond to the play as a credible representation of story at the same time it is consciously responding to formal artistic composition. Continuing audience awareness of structure during representation should help to establish a point of view which will make artistically acceptable an action which might otherwise seem excessive and disproportionate.

Five plays are analyzed to show the kind of study a director should make: *Andromaque*, *Britannicus*, *Athalie*, *Bajazet*, and *Phaedra*. For the purpose of analysis five criteria are used to describe structure in each of these plays. These criteria are: (1) the organic relationship of incidents to action, (2) the manner in which the incidents are articulated, (3) the effect of proportion among the various elements of the action, (4) the effect of completeness, and (5) the way the action progresses or "funds" to a final impression.

Having analyzed the action to determine how it is organized for impact, the director must then consider how he will embody this organization in production. The director should recognize the fact that the Racinian action will be communicated by a means that is more auditory than visual. Décor, costuming, movement and gesture of the actor should all be subordinated to the proper delivery of the verse.

The delivery will be self-consciously rhetorical. It will take into account the measure, the melody, and the rhythm of Racine's various kinds of Alexandrines and will be much more "operatic" than "naturalistic." At the same time the actor is being trained to make a full response to the musical character of the language he will also be trained to perform so as to convince the audience of the emotional truth of the dramatic experience. The actor must understand that the reaction of the Racinian character is extra-emotional and he must learn to express this emotion in performance with force and ease.

By properly combining concentration on the formal aspects of delivery with concentration on the emotional force that underlies the action, the actor should be able to achieve a dominance over his material that will permit the audience to view the action objectively and thus to experience what is defined as "transparent" perception.

Microfilm \$3.15; Xerox \$10.80. 241 pages.



# HYPERNASAL VOICE: ITS RELATION TO GROWTH DISTURBANCE AND PHYSIOLOGICAL ACTIVITY

(L. C. Card No. Mic 58-7947)

Samuel Glen Fletcher, Ph.D.  
University of Utah, 1958

Chairman: Boyd V. Sheets, Ph.D.

The purpose of this study was to test the hypothesis that hypernasal voice of non-psychogenic, non-destructive disease, or non-surgical nature is the result of disturbances in growth and development, primarily of structures in the area of the palatopharyngeal isthmus and, secondarily, in the adjoining structures.

To test this hypothesis ten experimental subjects were chosen who had hypernasal voice without associated cleft palate.

The problem was approached primarily through the use of standard lateral x-rays and through the analysis of cinefluorographic studies of swallowing, phonating, blowing, and inflating the pharynx. A procedure for tracing and analyzing cinefluorographic studies was developed and described. The data thus collected were supplemented by laminagraphic and Fairchild camera x-ray studies, case histories, and clinical observation.

The following areas of emphasis were included in the results: (1) background factors especially prominent in the case histories of the experimental subjects; (2) cephalometric measurements of the two groups of subjects with the apparent deviations of the experimental group; (3) movements of the posterior pharyngeal wall of the control subjects; (4) gross movements of the tongue, soft palate, and posterior pharyngeal wall of the experimental subjects; (5) extent of palatal elevation in the two groups; and (6) additional findings from clinical observations and still x-rays of the experimental group of subjects.

On the basis of the data obtained, the following conclusions seem warranted:

1. There seems to be a strong tendency toward the following conditions in a child having hypernasal voice quality: repeated and severe upper respiratory infections, neurological disturbance either in his own or in his familial background, nasal regurgitation which is usually displayed during the early weeks of infancy, and retarded onset of speech.

2. A summary of developmental disturbances of the experimental subjects indicated that each of them had anomalies in the growth and development of one or more of the following structures: lips, teeth, tongue, palate, uvula, pharynx, basicranium, or cervical vertebrae. A disturbance in one structure of the maxillary branchial region tended to be reflected in adjoining structures on the same anatomical level or plane. The findings indicated that these anomalies may extend from the lips to the cervical vertebrae or may encompass any section of structures on this level.

3. Unusually obtuse cranial angles seemed to be reflected in enlarged antero-posterior dimensions of the nasopharynx.

4. It is suggested, on the basis of this study, that Passavant's ridge could be formed by either of two mechanisms. In those subjects having ridges formed in relation to palatal activity, fibers from the palatopharyngeus were probably responsible. In the eight experimental subjects

displaying ridges only in relation to activation of the posterior pharyngeal wall, the ridges were probably due to fibers from the superior constrictor. These latter ridges could be the result of a unique maturation of certain fibers from the superior constrictor as a compensatory adaptation because of disturbance in the palatal valving necessary to close the nose from the pharynx in the swallowing act.

5. One of the most significant findings was that in eight of the experimental subjects there was no palatal contact during any activity other than swallowing and there was no anterior movement of the superior portion of the posterior pharyngeal wall. Thus, when the variables of palatal and bolus contact with the posterior wall of the pharynx were eliminated, anterior movement of the posterior wall was also eliminated. This would suggest that the posterior wall of the pharynx is exquisitely sensitive to mucosal or exteroceptive stimulation such that a previously unidentified reflex movement of the superior portion of the posterior wall is activated following contact by the soft palate or by a bolus of food.

6. An obturator with a moveable bulb was designed and constructed through which the reflex activity of the superior portion of the posterior wall could be utilized. This was placed in the nasopharynx of an experimental subject in such a manner that the palatal elevation caused contact of the bulb with the posterior pharyngeal wall. Previous to the use of this obturator there was no apparent movement of the posterior wall of this subject in any activity except swallowing. When phonating with the obturator in place, there was extensive anterior movement of the superior portion of the posterior pharyngeal wall.

7. The extreme range of palatal elevation during phonatory efforts of the experimental subjects points to a lack of consistency from one activity to another. This could possibly indicate that these children as a group do less monitoring of their voice during phonation than do the children without voice quality disturbances.

8. The two groups did not differ significantly in medial palatal elevation. This would suggest that a diagnosis of insufficient palatal elevation should be used with extreme caution. Microfilm \$2.00; Xerox \$6.80. 142 pages.

## RHETORICAL THEORY IN AMERICAN COLLEGES AND UNIVERSITIES, 1915-1954

(L. C. Card No. Mic 59-213)

Joseph Brannon Laine, Ph.D.  
Northwestern University, 1958

Supervisor: Glen E. Mills

The purpose of this study was to investigate the development of rhetorical theory, the principles and methods of speaking and listening, in American colleges and universities between 1915 and 1954.

The materials consisted in journal articles and selected college textbooks in basic speech, argumentation and debate, discussion, speech composition, and persuasion. The books in basic speech, argumentation and debate, and discussion were selected in part on the basis of a questionnaire which sought to estimate their wide use. Each book was examined in terms of its approach and purpose,



organization and content, emphasis, influences, and outstanding features or contributions. The books were considered against a background of developments in the field of speech during the period under study.

Among the developments which affected rhetorical theory were the establishment of separate departments of speech, the founding of the Speech Association and the *Quarterly Journal*, the organization of the Research Committee, and the shifting in areas and curriculum and in the basic course highlighted by the waning of elocution, the growth of public speaking, the continued emphasis in argumentation and debate, and the introduction of discussion and general semantics.

The books in basic speech were divided arbitrarily into ten-year periods beginning with 1915. The first period is best characterized as one of transition between elocution and modern public speaking. The second period witnessed a greater stress on the principles and types of public speaking, the beginning of a movement toward general speech, the introduction of discussion (largely informal advocacy), and a strong influence of modern science on some works. In the third period were found the appearance of military and brief editions, a greater influence of contemporary research in speech and psychology, the introduction of general semantics, and an increased attention to discussion and conference (with greater stress on reflective group inquiry and the Dewey thought process), argumentation, parliamentary procedure, and radio speaking. The fourth period saw a greater conformity in basic concept than in earlier periods, the maturity and wide-spread emphasis of the general speech approach, a balanced treatment of classical rhetorical canons supplemented by the findings of contemporary research, an extension of the emphasis on discussion, general semantics, and radio speaking, and the adaptation of speech methods to television.

The books in argumentation and debate, and discussion were divided arbitrarily into two approximately twenty-year periods. The first period was characterized by an emphasis on accurate thinking and on principles of argumentation with applications to debate, a strong influence of the fields of logic and law, and the appearance of the first widely-used book to give extensive treatment to discussion (essentially as informal advocacy). The second period indicated continued stress on principles of argumentation, greater attention to various forms of debate, much greater stress on discussion and group leadership, stronger influence of contemporary research in speech and psychology, and the publication of the first widely-used book to give comprehensive treatment to discussion conceived of as reflective deliberation and following the Dewey thought process.

The books in speech composition and persuasion grew out of the demand for advanced courses in public speaking. The speech composition books generally stressed the nature of oratory or public speaking, the interrelationships of speaker, speech, audience, and occasion, the purposes and various arrangement patterns of speeches, the logical and psychological factors in persuasion, and the principles and methods of style. They gave little direct attention to delivery. The books in persuasion emphasized background study in human nature and neurological response mechanisms, and treated methods of audience analysis, motivation, gaining attention and interest, and psychological and logical approaches in securing stimulation, belief, and action. Microfilm \$6.80; Xerox \$23.40. 535 pages.

## LYMAN TRUMBULL AS A SPEAKER, 1837-1896

(L. C. Card No. Mic 59-540)

Lucille Marie Magnon, Ph.D.  
University of Illinois, 1958

This study examines the career of Lyman Trumbull as a speaker between 1837 and 1896. In seven chapters the investigation analyzes the man, the occasions upon which he spoke, the audiences that responded to his speeches, the major issues that confronted him during his public life, his ideas about those issues, and the rhetorical means which he employed to make those ideas effective. Appendices are devoted to a complete list of Trumbull's speeches and colloquies in the United States Senate, 1856-1873; a list of the cases he argued before the Illinois supreme court, 1839-1847, 1853-1855, and 1873-1876, and before the United States Supreme Court, 1860-1895; a list of his opinions as an associate justice of the Illinois supreme court, 1853-1855; and a list of his political speeches and the requests he received for such, 1837-1894. The study is selective in scope in that it concentrates more heavily upon the speaking Trumbull did as a lawyer and a campaigner than on the speaking he did on other occasions.

The greatest single primary source used was the Lyman Trumbull MSS Collection owned by the Library of Congress. Two other Lyman Trumbull collections owned by the Illinois Historical Library were consulted as well as numerous manuscript collections of Trumbull's contemporaries found at the Illinois State Historical Library, the Illinois Historical Survey, and the University of Illinois Library. Other sources such as newspapers, published letters, diaries, histories, biographies, government documents, and unpublished theses gave the writer further insight into her subject.

As a practicing young lawyer Trumbull advanced to fill some of the highest positions on the state and national levels and became one of Illinois' most distinguished citizens, the third member of the early triumvirate--Lincoln, Douglas, and Trumbull. His career exemplified profound respect for law and a high moral courage which enabled him to defend his ideas.

The legal cases in which Trumbull excelled were those argued in appellate courts. After devoting himself to careful preparation and organization of his cases, he sought judicial favor through the force of his intellect before audiences of highly critical and intellectually superior justices. His chief weaknesses as a forensic speaker stemmed from a rather cold personality which prevented him from getting close to his audience and an unimaginative style which prevented him from dressing his thoughts splendidly. While these weaknesses barred him from great eloquence, he was nevertheless an effective pleader and an eminently successful lawyer.

As a leader in various movements for the realignment of political forces in a period characterized by much shifting in political parties, Trumbull's campaign speeches were lavished upon electorates in a continuous series of meetings of every kind, of every shade of importance, from mass meetings which attracted thousands to gatherings in our-of-the-way spots attended by a handful of people. Before audiences in Illinois and in the nation he delivered lengthy, well prepared, clearly organized, argumentative speeches on a variety of themes. His reputation



was that of a keen political debater rather than that of a rabblouser. His chief weakness as a political debater was that he relied too heavily on intellectual force in a day when leadership was sustained by less elevated means.

Trumbull was one of the few men in the political and legal history of Illinois who succeeded in following with little or no deviation the dictates of his own conscience. His influence on the legal and political scenes was greater than his reputation. His career could be described as one of lasting usefulness rather than brilliant display.

Microfilm \$3.80; Xerox \$13.00. 236 pages.

#### METHODS OF EXPERIMENTATION IN RADIO RESEARCH, AND CORRELATES OF EFFECTIVE RADIO ADVERTISING

(L. C. Card No. Mic 59-724)

Merle Scheffel Pierce, Ph.D.  
The University of Wisconsin, 1958

Supervisor: Dr. Henry Lee Ewbank, Sr.

Using a 30 minute tape-recorded simulation of radio programming as the stimulus, audience responses to radio advertising were compared for a stratified laboratory sample, an unstratified laboratory group, and a field sample; for electrical audience-analyzer and paper-pencil response instruments; and for various program and audience components hypothesized as influencing radio's effectiveness.

The 3 chapters report, first, the objectives and methods of the study; second, the data and findings; and, third, the observations and conclusions. The appendices contain the program manuscript and 3 questionnaires.

The recording simulated a segment of recorded music, a live drama, and a sports commentary. Also included were 10 spot announcements and 4 station breaks. The experimental groups were university students, occupational therapy patients in a metropolitan hospital, and families in their own homes. Some sub-groups of university students used the Wisconsin Sequential Sampling Audience Analyzer to indicate their reactions on a like-neutral-dislike response scale, others used a paper-pencil response instrument, and one subgroup for control purposes used no response instrument.

The hospital participants heard the recorded program together but the field sample, consisting of individuals or family groups, listened in private homes.

Before a participant in an experimental group heard the recorded program, he completed a questionnaire requesting biographical, educational, socio-economic, radio diary, and attitudinal information. He also indicated brand or product preferences in each of 10 categories represented by commercial announcements in the recorded program. As each group completed the pre-test questionnaire, the recording was heard, then a post-test questionnaire was administered. This second questionnaire included a random re-ordering of the preference items, evaluations of the program, and an identification item. Delayed post-test responses were received one week to 7 months after the recording had been heard. In addition to another re-ordering of the brand preference items, the

delayed post-test contained a recall identification of program "sponsors".

This is primarily a pilot study of method. The size of some groups was too small to produce statistically significant results; however certain conclusions seem warranted. Those relevant to radio research methodology follow: First, although not as reliable as test-retest results with the Analyzer, the paper-pencil instrument can be substituted for the Analyzer within the 5% level of confidence. Second, suggestibility of radio advertising appeared greater for the field sample than for either of the laboratory groups. Third, suggestibility also seemed greater for the unstratified sample than for the stratified sample.

Investigation concerning program and audience components of radio's advertising effectiveness indicated the following: First, the sales effectiveness of a commercial announcement appears to hold a positive correlation with the listener's dislike of that announcement. Second, recall identification of an advertised item does not affect the listener's readiness to buy that product or brand, but recall of the announcement does increase the probability that whatever response the commercial message initially achieved will be retained. Third, men seem to retain longer than women their initial influence to buy a brand or product advertised by radio. Fourth, radio does influence the listener to buy advertised brands or products immediately after the broadcast, and, although diminished, the initial influence continues after a period of one week or more. Fifth, radio is more likely to influence a listener's readiness to buy an advertised item if that item is unfamiliar to him. Sixth, radio's influence is apparently greatest with young adults in upper economic strata who have not earned a college degree. And, seventh, the most effective commercial announcement is one minute long, blends with adjacent program materials, and advertises an intangible item.

Microfilm \$2.00; Xerox \$5.80. 119 pages.

#### HUMOR IN TRAGEDY

(L. C. Card No. Mic 59-1292)

Calvin King Quayle, Ph.D.  
University of Minnesota, 1958

Adviser: Frank M. Whiting

This thesis presents a study of the values and functions of humor in tragedy, with special attention given to the elements of humor in the following six tragedies: Oedipus Rex and Antigone by Sophocles, Hamlet and Antony and Cleopatra by Shakespeare, Ghosts and Rosmersholm by Ibsen.

The final chapter of the thesis presents the conclusions drawn from the study. One of the most important aspects of humor in tragedy is the use made of humorous material to demonstrate or establish character personalities and character relationships. This is accomplished in several ways. The character who is portrayed by the author as humorous (as the object of humor) is usually shown to be inferior to the other characters in the play or to the reader. This is especially true if the character is held



up to ridicule. On the other hand, that character portrayed by the author as using humor at the expense of other characters: laughing at them, ridiculing them or "playing" with them, is shown as in a superior position in relationship to those characters. In addition to demonstrating his superiority by the use of humor in this manner, a character may also use humor as a defense or as a weapon against his antagonists in the play.

Accepting the position that a sense of humor is a part of a larger ability to abstract the obscure from the obvious, the tragic character who demonstrates a sense of humor also demonstrates a high degree of awareness and of intelligence. This sense of humor also serves as an adjustive mechanism, or a means of emotional "relief" for the tragic character.

For the reader of the tragedy, in addition to the insights to the play provided by the functions listed above, humor in tragedy may serve two definite functions. The first is that of "comic relief" from the emotional tensions of the tragedy. The second is an increase of the sense of the tragedy by a "contrast" between the humorous and the tragic. The element of humor in tragic irony has a similar effect upon the reader. It tends to lessen the identification with the tragic implications of the irony but, at the same time, adds a definite poignancy to the irony due to the clash of emotions which irony arouses.

Accepting the position that humor makes its point indirectly, the thesis shows that elements of humor in tragedy are sometimes used by an author to suggest ideas, meanings, or subjects which he cannot or does not wish to treat directly.

This study concludes that the elements of humor in the tragedies analyzed in this thesis are an integral part of the tragedies. The deletion of the humor from the plays would change their very nature and a very real part of the plays would be lost. The actor or director who does not perceive and exploit the elements of humor in producing a tragedy and the critic who ignores the humor in analyzing a tragedy falsify the play as it was written by the author. Microfilm \$3.70; Xerox \$12.60. 288 pages.

#### THE DEVELOPMENT OF COMMUNICATION PROCESSES IN THE PSYCHIATRIC INTERVIEW

(L. C. Card No. Mic 59-221)

Eugene Erving Rebstock, Ph.D.  
Northwestern University, 1958

Adviser: Franklyn S. Haiman

The purpose of this study was to trace the development of psychoanalytic thought with respect to the communication processes occurring in the psychoanalytic interview. It was thought that such a study would provide useful theory for the understanding of more general communication processes.

Toward this end, the study attempted to derive an explicit statement of the communication processes used in therapy. The statements were drawn from the writings of Sigmund Freud, Alfred Adler, Carl Gustav Jung, Sandor Ferenczi, Otto Rank, Wilhelm Reich, Anna Freud, Karen Horney, Harry Stack Sullivan, Franz Alexander, Carl Rogers and Jurgen Ruesch.

In order to facilitate comparisons among the various analysts, an analytic framework of two major divisions was established. The first division was designed to provide a vehicle for summarizing the characteristics of immature thought processes as seen by the various schools of thought. The second division was designed to show specific methods and techniques utilized in the therapeutic interview. The following categories were included:

1. Method of securing information.
2. Activity and response of the therapist.
3. Interpersonal techniques.
4. Metacommunication.
5. Role relationships.
6. Dynamic focus.

Using this framework, the statements of the therapists about what they do in therapy were summarized and analyzed. It was found that a generalized statement of the process of therapy would include the following major divisions:

1. Involvement.
2. Resistance.
3. Rapport.
4. Diagnosis.
5. Internalization.
6. Self-Motivation.

Throughout this process, the dynamic aspect of the personal relationship between the therapist and patient was considered to be the basis of therapeutic effectiveness. This relationship, of necessity, involved transference distortions. The various definitions and expressions of transference as they pertained to communication within the interview situation were explored.

As the theory of transference evolved, therapeutic techniques also changed. The relationship established between patient and therapist evolved from a mystical one to one that involved more of a relationship of mutual rapport. However, it was found that through all the changes in relationship, the basic elements outlined in the section on therapeutic techniques were utilized. This led to the conclusion that therapy as an art is analogous to persuasion as an art, for both require some structuring and control of the specific communication situation.

The conclusion was drawn that not only was the concept of transference a significant aspect of the persuasion process, but that transference relations permeate "normal" communication. It was suggested that mild transferences and projections are of use for understanding and communication, but when these same transferences become too intense, communication loses orientation in reality. It was further suggested that the participants to communication should attempt to make their messages as specific as possible to avoid the more intense of the transference distortions. Microfilm \$6.10; Xerox \$21.20. 479 pages.



# THE IMPACT OF JOHN R. BRINKLEY ON BROADCASTING IN THE UNITED STATES

(L. C. Card No. Mic 59-222)

Ansel Harlan Resler, Ph.D.  
Northwestern University, 1958

Supervisor: Martin J. Maloney

This study deals with "Dr." John R. Brinkley, notorious "goat-gland" doctor of the nineteen twenties and thirties, and his use of communications media to further his personal, political, and medical career. Particular focus is given to the effect and influence which his various activities had upon the development of broadcasting in the United States.

The study is divided into three major parts. The first part, The Brinkley Story, is a biography which describes the major eras of Brinkley's career. The period 1885-1917 relates the activities of his boyhood and his early years of medical preparation. The Kansas Era (1917-1931) deals with the time when he rose to national notoriety with the "goat-gland" operation. During this period he acquired a radio station which became a major tool in the propagandizing of his medical services.

The Del Rio Era (1931-1942) found a gradual transferring of his medical and broadcasting operations to Del Rio, Texas. His broadcasting transmitter was located across the Rio Grande in Villa Acuna, Mexico, and became the center of the border station "menace." This resulted in lengthy diplomatic negotiations between Mexico and the United States. He also ran for governor of Kansas three times, almost being elected twice. The later part of the Del Rio Era found Brinkley running into trouble with the Mexican government, losing a libel suit he brought against Morris Fishbein of the American Medical Association, facing a suit by the United States Post Office department, taking voluntary bankruptcy, and finally dying as a result of complications brought on by the amputation of his leg.

The second major part of the study deals with an attempt to analyze the personality of Brinkley through a content assessment of communications materials, written by Brinkley and others, in order to get a picture of the kind of a man who affected an influence upon the early development of the broadcasting medium which he had used to such a personal advantage.

The analysis finds Brinkley endowed with contradictory personality traits. His opponents saw him as greedy, insincere, and possessing false piety. On the other hand, his followers characterized him with traits of beneficence, martyrdom, honesty, humility, and religious piety. Brinkley continually emphasized his dual role of the hero-idol and identification with the common man. He possessed strong characteristics of leadership. He seemed to have a native understanding of "grass-roots" psychology which allowed him to exercise persuasive techniques that resulted in amassing a large group of followers as well as a personal fortune of millions of dollars.

The final part of the study attempts to evaluate the effect and influence which Brinkley had upon four phases of radio broadcasting: his effect upon broadcasting techniques, programming, rules and regulations, and international communications agreements.

The impact of Brinkley upon broadcasting was largely indirect. The major areas of influence lay in the informal,

personal approach to radio speaking, the use of electrical transcriptions, political campaigning by radio, early educational broadcasting, the use of radio for advertising and propaganda purposes, and a negative influence on medical broadcasting. In addition, the decision of the Federal Radio Commission which took away Brinkley's broadcasting license stands as a precedent in strengthening the governmental right to control broadcasting as it affects the "interest, convenience, and necessity" of the American people.

The most direct influence which Brinkley had upon the development of broadcasting is in the area of international communications agreements. He was almost solely responsible for the part of the Havana Treaty which settled broadcasting problems between Mexico and the United States as they related to border station operation between the two countries.

Microfilm \$4.25; Xerox \$14.20. 330 pages.

## A PRELIMINARY EXPERIMENTAL STUDY OF THE EFFECT OF SPEECH ASSIGNMENTS ON THE SPEECH FEAR REPORTED BY STUDENTS IN BEGINNING SPEECH CLASSES

(L. C. Card No. Mic 59-607)

Walter E. Simonson, Ph.D.  
University of Minnesota, 1958

The main purpose of the study was to determine whether the nature of the speech assignment was a major determining factor in the amount of speech fear experienced by beginning speech students. Secondary purposes consisted of trying to determine the effect of sex, the nature of the school, and reported extroversion on the speech fear. An attempt was also made to discover which assignments were preferred by the students and what effect speech fear had on those preferences.

The experiment was conducted at the University of Minnesota and at the Wisconsin State College at River Falls. On the first day of class each student was asked to complete a copy of the Gilkinson-Knowler Guidance Questionnaire for Students of Speech to which had been added the Root Extroversion-Introversion Scale and a question asking the student to state which of five assignments he would prefer. Then the five assignments: discussion, persuasion, informative speaking, oral reading, and relating a personal experience, were randomly assigned among the classes at the two schools. After each student completed the speech he was assigned, he was asked to complete the Personal Report on Confidence as a Speaker (PRCS). The PRCS scores were then subjected to statistical analysis.

The first step in the statistical analysis consisted of examining the frequency distribution of PRCS scores. It was discovered that the distribution was not normal but rather approximated a bimodal pattern. As a result, normal curve statistical methods could not be used. The nonparametric test which appeared most suitable was the Kolmogorov-Smirnov test which operates on the differences between the cumulative frequency distributions of the groups being compared. This test is nearly as powerful as the parametric "t" test.



Statistically significant differences were found between the assignments studied. It was found that the relative ranking of these assignments in terms of their fear generating potential varied according to sex, course, and school. In general, oral reading appeared most productive of speech fear except among the women enrolled in Speech 5 at the University of Minnesota. Persuasive speaking was the most conducive to confidence for most of the students at the University of Minnesota, but it was a high causer of fear at the Wisconsin State College. Informative speaking was the most conducive to confidence at the State College, but it was the most fear inducing on an overall basis for the University students. The relating of personal experiences appeared to rank about midway in fear generating ability. However, it tended to produce more fear among women than men. Discussion was conducive to speech confidence among the River Fall students but tended to cause speech fear among the University students. This assignment also appeared to cause more fear among women than men.

Statistically significant differences between the sexes were found in this study. In general, the women reported more speech fear than did men. The only exception occurred in the oral reading assignment. In that instance the men at the University of Minnesota reported more fear than the women. The sex differences are most pronounced in the discussion and personal experience assignments.

Statistically significant differences between the two schools studied were also discovered. The River Falls students reported more speech fear than those at the University. Variation between the instructors at the two schools may account for at least some of the difference between the schools.

Marked differences were found between the preferences for alternative assignments by students of high and low degrees of speech fear. In both schools the students reporting the greatest speech fear expressed a preference for those assignments which were the most productive of speech fear. The high confidence student preferred those assignments most conducive to confidence for the school in which they were enrolled.

A low but statistically significant correlation between introversion and speech fear was found at both schools. The correlation was higher (.42) at the University than at the State College (.18).

Microfilm \$2.00; Xerox \$6.20. 127 pages.

#### AN INVESTIGATION OF THE MATURATION OF VARIOUS FACTORS OF AUDITORY PERCEPTION IN PRE-SCHOOL CHILDREN

(L. C. Card No. Mic 59-225)

Ellen Marie Spencer, Ph.D.  
Northwestern University, 1958

Supervisor: Helmer R. Myklebust

This study was undertaken as an investigation into the area of auditory perception as it relates to the capacity of the maturing organism to deal with auditory stimuli, to develop speech, and to acquire facility in identifying, recall-

ing, reproducing, analyzing, and synthesizing complex sounds and sound patterns. Various factors and relationships of auditory perception were outlined, and a review of the literature with respect to these factors was presented. The subjects for the investigation were eighty normal children, ten at each of eight age levels from two and one-half through six years of age, with hearing, speech, and intelligence within normal limits as established by appropriate screening techniques.

The test materials consisted of fourteen tests designed to evaluate the ability of the child to recognize sounds; to discriminate between the sounds of speech; to recall and reproduce series of sounds of varying complexity, using different types of materials as stimuli; to analyze and synthesize the sounds of speech; to match pitch; and to reproduce rhythms and melodies.

The results were analyzed for relationships to chronological age, mental age, and sex differences; percentile curves were drawn for each sub-test to demonstrate its effectiveness as a test for the varying age levels; and a correlational analysis of all sub-tests was made to determine intertest relationships. In addition, a summary of the test results of nineteen children who were excluded from the sample group because they failed to pass the screening tests was presented for comparison with the normal group.

Significant positive correlations with mental age and chronological age were reported. No significant sex differences were found. The adequacy of the various sub-tests as measures appropriate for the age range and for the abilities under investigation was discussed.

Microfilm \$2.10; Xerox \$7.40. 157 pages.

#### A RHETORICAL CRITICISM OF THE RADIO PREACHING OF WALTER ARTHUR MAIER

(L. C. Card No. Mic 59-226)

Kenneth Hartley Sulston, Ph.D.  
Northwestern University, 1958

Supervisor: Leland M. Griffin

This is a study of the radio preaching of the Reverend Dr. Walter A. Maier, professor of Old Testament at Concordia Theological Seminary in St. Louis, whose sermons were heard over the weekly broadcasts of the Lutheran Hour in the period from 1930 to 1950.

After an ill-fated beginning in 1930, the Lutheran Hour returned to the air in 1935, being broadcast over two stations of the Mutual Broadcasting System. At the time of Dr. Maier's death in 1950, the program was being broadcast over the complete facilities of the Mutual network; 199 stations of the American Broadcasting Company were also releasing the Lutheran Hour; it was being broadcast by transcription over 698 additional stations in the United States and in forty-seven foreign countries; Dr. Maier's sermons were being translated into thirty-five languages for rebroadcast over the foreign-language stations; weekly mail response from listeners was averaging 13,000 pieces of correspondence per broadcast.

The purpose of this study was to examine the radio preaching of Dr. Maier which had elicited such a significant



response. Manuscripts of 502 radio sermons and recordings of four broadcasts of the Lutheran Hour provided the most significant primary sources. Analysis of Dr. Maier's rhetorical practice in the four recorded sermons constituted the major emphasis of this investigation, the contextual background for which was provided by a study of Dr. Maier's life and the historical setting in which his radio ministry took place.

The study revealed the two-fold nature of the purpose underlying Maier's radio ministry: (1) to win his hearers' acceptance of the Christian faith, and (2) to defend the Fundamentalist interpretation of that faith from the attacks of theological liberalism. To accomplish his purpose, Maier relied heavily on emotional proof. His logical proof was weak, often ignoring, or at best summarily dismissing, evidence in support of positions contrary to his own. The speaker's main strength in argument lay in his own ethos, by which his audience was permitted to appraise his competence, sincerity, and deep concern for his listeners' spiritual well-being.

Maier favored the problem-solution method in the arrangement of his materials, by which the problem raised by man's failure to conform to God's law found its solution in the provisions of the Gospel.

Dr. Maier's style was made highly personal by his frequent use of personal pronouns, imperative sentences, requests, and rhetorical questions. Such a style, requiring a personal response from the listener, was particularly well suited to the radio speaking situation.

The speaker's vocal production was that of a scolding, authoritarian figure. The voice was harsh, sometimes strident; the pace was rapid; the volume was strong -- a frequent source of difficulty for radio engineers. The over-all effect of delivery was one of compulsiveness.

The most significant conclusion to be drawn from this study concerns the nature of Maier's listening audience. It was an audience belonging to a society frustrated and disillusioned by the collapse of its dream of prosperity in the thirties and of its hopes for peace in the forties. It was a society in search of certainty and willing to give ear to any voice which professed to provide that certainty. Walter Maier's authoritarian, supernaturalistic interpretation of the Christian Gospel offered just such a certainty in religious matters. The study concludes that the enthusiastic response which greeted Maier's preaching over the twenty-year period from 1930 to 1950 was therefore a product of the times to which he spoke.

Microfilm \$7.65; Xerox \$26.20. 601 pages.

**A STUDY IN RHETORICAL CRITICISM OF  
CHARLES G. DAWES, THE SPEAKER  
(VOLUMES I-III)**

(L. C. Card No. Mic 59-232)

Donald Edward Williams, Ph.D.  
Northwestern University, 1958

Supervisor: Wayne C. Minnick

Charles Gates Dawes (1865-1951) had a public speaking career which was remarkable in both its span and its di-

versity. In the late 1880's, he was speaking against the powerful railroad interests in Nebraska; he was still the outspoken advocate in 1940 as he contended that the United States should not enter into a war against Germany.

After his speaking had earned for him his widely publicized and lasting sobriquet, "Hell and Maria" Dawes, in 1921, he became a speaker of state, national, and world distinction. During the 1920's, he spoke as the first Director of the Federal Budget, as head of the Minute Men in Illinois, as Chairman of the Experts' Committee on war reparations in Paris, as the Republican candidate for Vice President, as the Vice President who refused to be subdued by the traditionally restrictive confines of the office, and as United States Ambassador to Great Britain.

As an overall evaluation of Dawes as a speaker, viewed as a man in public life, he was about average. His attributes as a public speaker were such to make him a popular but not a great one.

His own concepts as to what made for effective speaking explain to a certain extent the whys of his demonstrated abilities and limitations in the art of persuasion. He assigned special importance to the role of ethos in speaking, he placed more faith in appeal to "human nature" than in appeal to "human reasoning," he gave special attention to providing clarity in organization and in wording, and he believed that a vigorous physical and vocal delivery evidenced sincerity.

Thus, while he obviously had an appreciation for the three modes of proof -- logical, emotional, and ethical -- and what they entailed, he was unable to provide for that judicious blend of the three which enables each to serve the speaker's purpose the most efficaciously. Similarly, the demands which his speaking efforts made of him, from the standpoint of rhetorical invention, were beyond his capacity. Compensating somewhat for these inabilities was his ability to execute speech plans which usually had a power of conviction within themselves as they forcefully developed coordinated thought units; yet his style was often unimaginative and crude. His delivery, in addition, was excessively animated to the point of being distracting.

One cannot have the best understanding of Dawes, nevertheless, unless his speeches are studied. Public speaking was an important part of his life; in order to gain support for the many causes he sponsored, he relied on the platform. In doing this, being able to sense accurately the prevailing tenor of thought, he was the reflector and the intensifier of existing public sentiment rather than its creator; while others remained silent, he gave meaningful expression, following World War I and during the 1920's, in particular, to the often unvoiced attitudes of the inarticulate layman on public questions. Speaking at this time, Dawes reflected popular feeling as well as indicated that he had more than a surface grasp of social and political problems; studying his speeches of this period, therefore, provides understanding of how this leader in public affairs considered and reacted to the various anxieties and difficulties which beset United States citizens in the decade of normalcy.

In the light of these observations, it is not surprising that many remember Dawes more for his public speaking than for anything else.

Microfilm \$18.50; Xerox \$66.20. 1470 pages.



## ZOOLOGY

### THE EFFECT OF METABOLIC INHIBITORS ON CYTOPLASMIC VISCOSITY, SURFACE RIGIDITY AND CLEAVAGE OF *ILYANASSA* EGGS

(L. C. Card No. Mic 58-5119)

Joseph M. Butros, Ph.D.  
Emory University, 1953

The relationship between the colloidal phenomena and the energy yielding phenomena in cell division was investigated by studying the simultaneous effects of enzyme inhibitors on cytoplasmic viscosity, surface rigidity and cleavage. The work was done on *Ilyanassa* eggs that show a normal fluctuation in viscosity varying from high in the lobeless (round) to low in the lobed stages with a slight rise at the time of the furrow.

Eggs that had completed their maturation divisions were treated with the various inhibitors described below for about one hour, then centrifuged with their controls at moderate forces (400 g-1600 g) for about 7 minutes. Relative viscosity was determined by comparing the times or forces required to bring equal stratification in treated and control eggs. Relative surface rigidity was determined by the relative centrifugal forces necessary to fragment treated and control eggs, or by the amount of elongation of the eggs upon centrifugation. The effect of the agents on the nucleus was also studied from cytological preparations.

Sodium azide (M/1000-M/200 at pH 6.6), monoiodoacetic acid (M/1000-M/200 at pH 6.0) and trichlorophenol (0.003% at pH 8.1) increased the viscosity and decreased the surface rigidity while blocking the nuclear and cytoplasmic divisions. Potassium cyanide (M/10,000-M/100) did not block cleavage, and caused a slight increase in the surface rigidity. Thiourea at a concentration (1.0%) that did not block cleavage, caused a decrease in viscosity and probably in surface rigidity. At 2.5 per cent it blocked nuclear and cytoplasmic divisions, increased the viscosity and decreased the surface rigidity. Chloral hydrate (0.12%) blocked division, decreased viscosity and probably decreased surface rigidity. All effects were reversible in all agents, but to a limited extent in iodoacetic acid.

Eggs that were treated with the agents at a short interval prior to cleavage, were able to divide. When centrifuged, these divided (treated) eggs showed that the viscosity change had taken place. Thus division took place in spite of either lower (as in chloral hydrate) or higher viscosity (as in azide).

The relationship between the colloidal and metabolic events of division are discussed in the light of these findings.

Microfilm \$2.00; Xerox \$4.00. 72 pages.

### THE EFFECTS OF X RADIATION ON THE EARLY CLEAVAGE STAGES OF THE SNAIL, *ILYANASSA OBSOLETA*

(L. C. Card No. Mic 58-5120)

James Newton Cather, Ph.D.  
Emory University, 1958

A study of the characteristics and duration of the meiotic and mitotic stages during the early development of the prosobranch gastropod *Ilyanassa obsoleta* Stimpson was made and correlated with the external morphological features of the egg and blastomeres. The effects of x radiation on these stages were determined by recording the duration of the cleavage delay produced in the first three cleavages, and the prolongation of the related mitotic stages, as well as the morphological changes visible in living and fixed eggs.

The chromosomes in the germinal vesicle of unfertilized eggs are in pachytene. When the egg is fertilized, the germinal vesicle breaks down and the eggs complete a typical molluscan type of meiosis, with amphiastral divisions; the polar bodies are completely cut off. The egg and sperm are both thought to contribute to each of the division centers for the first cleavage. The formation of the telophase nucleus was studied after fixation in alcohol-acetic, hydrolysis, and staining in Gomori's or Feulgen's stains. During telophase the nuclear membrane appeared to be formed from the achromatic pellicle of the chromosomes. The chromonemata themselves form the reticulum. Evidence was found for an attachment or attraction of the centromeres at the nuclear membrane next to the centrosome, and for a consequent orientation of the chromosomes in the nucleus.

At 23<sup>+</sup>1° C the duration of the metaphases and anaphases, both meiotic and mitotic, is about 10 minutes. Telophase I lasts 10 minutes, telophase II 30 minutes, and mitotic telophase 25 minutes. Prometaphase II lasts 10 minutes, as does prometaphase before the first cleavage. Prometaphase before the second and third cleavages lasts 5 minutes. Interphase has a duration of 30 minutes and prophase a duration of 25 minutes.

When eggs are irradiated 5 minutes after the commencement of pronuclear interphase, the cleavage delay increases sharply with the dose up to 4,000 r. Above this dose there is a slight increase to 10,000 r, but as the dose increases above 5,000 r, the lethality before blastulation increases.

Irradiation during telophase causes the greatest delay in the next cleavage. The elongation of the chromonemata is partially inhibited and probably interferes with the normal formation of the daughter chromosomes of the next mitosis. The second most sensitive stage, with regard to cleavage delay, is a short period in interphase which is postulated to be the time of DNA synthesis.

Little or no delay in the ensuing cleavage is caused by irradiation in stages from prophase to that cleavage, but



the delay of the following cleavage increases, reaching a maximum when treatment occurs in telophase. The third cleavage following treatment shows a similar but smaller effect, indicating recovery.

The mitotic stage showing the greatest increase in duration is prophase. Interphase is also appreciably prolonged but the other stages exhibit little or no effect. The delay in cleavage is primarily attributed to the difficulty of the separation of imperfectly formed chromatin strands in prophase. Microfilm \$2.00; Xerox \$4.20. 79 pages.

#### THE DIFFERENTIATION OF THE ENDOCRINE PANCREAS IN FETUSES OF ALLOXAN DIABETIC AND INSULIN-TREATED RATS

(L. C. Card No. Mic 58-5141)

Billy Eugene Frye, Ph.D.  
Emory University, 1956

Studies have been made to determine the time of functional maturation of the beta cells of the isles of Langerhans in the rat fetus and to clarify the role of fetal-maternal interaction in the morphogenesis of the islets.

Comparative histological and histochemical studies were made of fetuses of control, insulin-treated and alloxan diabetic rats between the 17th and 22nd days of gestation. In addition, quantitative studies were made of the relative islet size and number and the mitotic activity in the islets of both the control and the experimental groups. A total of 121 fetuses from 14 control rats, 92 fetuses from 11 insulin-treated rats and 100 fetuses from 13 alloxan diabetic rats were included in this study.

Granulated beta cells first appear in the islets of the 18 day fetus. In the controls the process of beta cell differentiation continues up through the 22nd day and is reflected as an increase in both the proportion of granulated beta cells and the intensity of the granulation within the cells. The beta cell differentiation in the islets of insulin-treated fetuses does not differ from the controls. Since this pattern of beta cell differentiation is exactly paralleled in the accumulation of histochemically demonstrable insulin in the islets, I conclude that the function of insulin elaboration begins on the 18th day of gestation, very shortly after the morphological differentiation of the beta cells.

The beta cells in the islets of fetuses of diabetic rats show progressive hydropic and degranulative changes, beginning on the 18th day, shortly after granulation has begun in the cells, and continuing until the 22nd day when extreme changes are seen. These changes are also paralleled by a decrease in the histochemically demonstrable insulin. Hence, as indicated by the liability of the beta cells to hyperglycemic stress, the function of insulin secretion also begins on the 18th day of gestation, shortly after the maturation of the insulin elaboration capacity.

Quantitative studies indicate that there is a significant increase in the relative quantity of islet tissue in fetuses of diabetic rats and a decrease in fetuses of insulin-treated rats, as compared with the controls. Hence, there is a definite fetal-maternal interaction in the growth of the fetal islets. Whether this influence is one of the maternal glycemia, blood insulin concentration, or other factors, cannot be ascertained from the present experiments. On the

basis of comparative counts of the islet concentration and the mitotic activity in the islets, it was determined that the growth effect is upon the mitotic activity in the islets and probably not upon the *de novo* origin of the islets.

Coincidental observations were made upon the effect of diabetes on sexual activity and the course of pregnancy in rats. Estrus is extended from 3.9 to 9.1 days in length, primarily through the extension of diestrus. There is a high rate of fetal abortion, in diabetic rats, prior to the 12th-14th days of gestation. Animals passing this stage successfully show no significant reduction in litter size. The fetuses of diabetic rats are, in some instances, significantly smaller than controls, an unexpected finding in view of clinical reports of increased infant size in infants of diabetic women.

Pregnancy had no effect upon the severity of maternal diabetes. A significant drop in the blood sugar level was seen just before term but is probably not related to fetal insulin production. To the contrary, the fetal glycemia is dominated by the maternal hyperglycemia and fluctuates in the same way as the maternal sugar.

Microfilm \$2.00; Xerox \$5.00. 99 pages.

#### THE LIFE HISTORY AND COMPARATIVE INFESTATIONS OF POLYPLAX SPINULOSA (BURMEISTER) ON NORMAL AND RIBOFLAVIN-DEFICIENT RATS

(L. C. Card No. Mic 59-385)

DeField Trollinger Holmes, Ph.D.  
The Ohio State University, 1958

In the course of checking through the available data on rat lice, it was noted that the complete life history of the rat louse *Polyplax spinulosa* was not described in the literature. The information found concerning the life history of this species of louse dealt with the number of stages and a description of these stages. It had been ascertained that the louse passes through five stages in its life cycle: the egg, three nymphal stages, and the adult stage. However, the length of time spent in each stage and the total length of time required for the completion of a generation on the host were not found.

The life histories of laboratory rats on normal diet and on riboflavin-deficient diet were determined and then compared.

The complete life history from the egg to the egg stage follows:

##### With Hosts on Normal Diet

Time from laying to hatching of eggs . . . .	5 days
First moult occurred after . . . . .	5 days
Second moult occurred after . . . . .	7 days
Third moult occurred after . . . . .	7 days
Sexual maturity occurred after . . . . .	2 days
Total . . . . .	26 days



#### With Hosts on Riboflavin-deficient Diet

Time from laying to hatching of eggs . . . .	5 days
First moult occurred after . . . . .	5 days
Second moult occurred after . . . . .	6 days
Third moult occurred after . . . . .	4 days
Sexual maturity occurred after . . . . .	2 days
Total . . . . .	22 days

The largest number of generations a year that could occur on the deficient rats is 17, and on the normal rats, 14.

The longevity of the females was greater than that of the males in both the normal and the deficient rats, the females living 28 days and the males, 25 days.

After 14 weeks of infestation, 3,484 lice were taken from four riboflavin-deficient rats. The lowest number on one host was 500, and the highest number was 1,300. The majority of the lice were found about the mid-body, where the greatest number of eggs were attached; the next area of heavy infestation was the shoulder and fore-body, and then the neck region. Few lice were found on the legs. More first stage nymphs were found than any other.

On the other hand, the rats kept on normal diet showed very low infestation after 14 weeks. Few eggs were found, and there seemed to be a tendency to lose the newly hatched nymphs. In all, 416 lice were taken from the four normal rats. As few as 50 lice were taken from one rat, and the highest number taken was 175. Greater numbers were found about the mid-body and then the shoulder and fore-body; few were found about the neck, and none on the legs.

It may be concluded that the host's nutrition and activity, such as vigorous scratching, appear to have some effect on the life history of the rat louse *Polyplax spinulosa*, which is an obligate and blood-sucking parasite throughout its life cycle. Those rats maintained on an abundance of riboflavin remained resistant, while rats deprived of riboflavin became highly susceptible to louse infestation. Microfilm \$2.00; Xerox \$3.00. 55 pages.

#### STUDIES ON THE IMMUNOLOGY AND SEROLOGY OF SCHISTOSOMIASIS

(L. C. Card No. Mic 58-3355)

Donald M. Levine, Ph.D.  
University of Pennsylvania, 1958

Supervisor: Irving G. Kagan

Immunity against schistosomiasis has been experimentally demonstrated in laboratory animals and many studies have been made on related serological reactions. However, the relationships of these reactions toward immunity and resistance are not very well defined, nor is the antibody mechanism for immunity against the schistosomes very clearly understood.

This investigation was undertaken to obtain a better understanding of the mechanisms of immunity and related serological reactions in schistosome infections. In addition an analysis of the schistosome parasite was made with agar diffusion methods in order to determine the antigenic

basis for the serological reactions, and their role in immunity.

A study was made of the *in vitro* reactions of cercariae of *S. mansoni* in the sera of 15 different animals. Reactions were studied in both normal sera and also in sera of animals injected with a cercarial homogenate.

Experiments were done testing the value of metabolic products of *S. mansoni* cercariae and adults, used in immunizing against schistosome infections in mice.

Two methods were utilized to test the value of antisera from infected animals in protecting the host against infections with *S. douthitti*. One method was bathing cercariae in serum before exposing mice to these cercariae and determining the extent of infection by means of worm counts. The second method was the passive transfer of antiserum from hamsters infected with *S. douthitti*, into mice which were then exposed to *S. douthitti*. Comparisons of the longevity of the control and experimental animals were made to evaluate the effects of the antiserum.

The antigenic analysis was done by means of the agar double diffusion technic, utilizing antigens prepared from the life cycle stages of *S. mansoni* and *S. douthitti*, and using serum from both injected and infected animals.

Various effects of normal and immune sera on cercarial activity were noted including cercariacidal and agglutinating properties and the "Cercarienhullen Reaktion" of Vogel and Minning. Immunization by means of cercarial and adult metabolic products significantly prolonged the life of mice as shown by statistical analysis.

Attempts to demonstrate the effects of bathing cercariae in antiserum before exposing mice were inconclusive by statistical analysis as a result of inability to control experimental variables, although in certain cases there seemed to be definite deleterious effects on the cercariae.

Results of passive transfer experiments were negative.

The number of antigen-antibody bands demonstrated in double diffusion tests (indicative of a minimum number of antibodies or antigens present in the system) varied from one to seven for the various life cycle stages of the schistosome parasites, and common antigens were shown in the various life cycle stages. Sera of infected animals contain antibodies which react with somatic antigens, metabolic products antigens, and egg antigens of schistosomes.

Microfilm \$2.00; Xerox \$3.00. 51 pages.

#### REGENERATION OF THE INTESTINE IN ADULT AMPHIBIANS

(L. C. Card No. Mic 59-147)

Wendall Keith O'Steen, Ph.D.  
Duke University, 1958

Supervisor: Edward C. Horn

The gross and histological aspects of intestinal regeneration were investigated in urodele amphibians from a series of operations designed to present a variety of experimental conditions. The operations performed were: one or two transections of the intestine with and without ligation of the free ends, the anterior-posterior reversal of a section, the removal of a section of intestine, and the



formation of a looped area in the anterior intestine after transection. Gross and microscopic observations were made on the formation of the blastema from intestinal tissues and from other coelomic organs and tissues.

Regeneration occurred in animals from all types of operations, but the pattern of the restoration was not identical in all cases. Adhesions of the intestinal surfaces, which preceded regeneration, involved either the two transected ends coming together or the transected end of one section fusing with the lateral surface of the other. When two transections were made, resulting in the formation of an anterior and posterior section and a midpiece, adhesion and subsequent regeneration involved all pieces of the intestine aligned in normal sequence in some cases, while in others the anterior end joined the posterior end without involving the midpiece at all.

The presence of mesentery adjacent to the transected ends was not necessary for the regeneration of the intestine. Two experiments, one involving the removal of a middle section, the other the formation of a loop in the intestine, separated the transected ends from one another by 1.0 to 2.0 cm; complete regeneration still occurred in these animals.

Whenever a transected intestinal surface contacted a section of the intestine or other coelomic organs, the formation of a blastema was associated with the immediate area of adhesion. The resulting blastema received contributions from all layers of the intestine and from such other organs as liver, fat body, gonads, parietal peritoneum, lung, urinary bladder, and oviduct, in that order of descending frequency. All tissues contributing cells to the blastema underwent marked changes in their histological pattern. The cells, as they passed into the blastema, dedifferentiated morphologically, and most of them could not be traced beyond the periphery of the mass. Some of these organs, such as fat body, ovary, and testis, showed definite signs of degeneration.

Intestinal tissues completed regeneration from the blastema in the following chronological sequence: mucosa, serosa, submucosa, and finally muscularis.

The blastemal mass gradually decreased as the new tissues regenerated. By the late stages of reconstitution (50-58 days) all tissues other than the intestine separated from the blastema, making it impossible to distinguish the original area of transection.

The reconstitution of the intestine with an anterior-posterior reversed section indicated the ability of the tissues to reform even when in contact with a region having a different histological structure.

A survey of the results from all experiments indicated that more females than males survived and regenerated. This was attributed primarily to the effects of starvation since the males did not have the mature ovaries with yolk-rich oocytes on which to depend for nourishment.

Overall deaths were relatively few (37.0%) considering the nature of the operations. In several animals the viscera were exposed to the external medium following a rupture of the lateral incision in the body wall without resulting in death. The primary cause of deaths, however, was peritonitis which appeared to develop as a result of detritus passing from the cut end of the intestine into the coelom.

Microfilm \$2.00; Xerox \$4.20. 77 pages.

# THE UTILIZATION OF FOOD PLANTS BY THE GRASSHOPPER, MELANOPLUS MEXICANUS MEXICANUS (SAUSS.)

(L. C. Card No. Mic 59-1302)

Dean Seyward Smith, Ph.D.  
University of Minnesota, 1958

Grasshoppers were reared individually from hatching to adult emergence. Each grasshopper was fed throughout the nymphal period on one of three plants, Renown wheat (*Triticum vulgare*), Ajax oats (*Avena sativa*), and western wheat grass (*Agropyron smithii*). The plants were grown in a greenhouse in vermiculite and supplied with nutrient solutions. Leaf blades were cut from these plants and placed in the cages with the insects in such a way that the cut ends were in water. Data were gathered for each five-day period from hatching to adulthood; these data included the fresh weight of food offered, the dry weight of uneaten food, the live weight of the insect, and the dry weight of the faeces excreted. Measurements were also made of the dry matter content of the insects and of the food and of the nitrogen content of late instar nymphs, their food and their faeces. Observations were made of survival, duration of nymphal development, and food preferences.

Differences in survival, duration of nymphal period, and final weights showed that the three plants differ in food value. Consumption of oats was only approximately one-half that of each of the other two plants and preference tests showed that oats was much the least preferred with little difference between the other two plants. The overall percentage utilization of the dry matter of the plants during the nymphal period was the same for all plants, 32 per cent, but the early stages of the grasshoppers showed striking differences in utilization as well as much higher values. Over the first five days these values were 81 per cent on western wheat grass, 68 per cent on wheat, and 54 per cent on oats. Efficiency of conversion of food to body tissue on a dry weight basis ranged from 26.6 per cent on western wheat grass to 37.6 per cent on oats with, again, greater differences in the early stages. There was a tendency for the efficiency to vary inversely with the amount of food utilized.

The diet had no effect on the nitrogen content of the insects despite the fact that the percentage of nitrogen in western wheat grass was slightly but significantly less than in the other two plants. There was a more efficient usage of nitrogen from oats than from the other plants, although this may have been consequent upon the smaller consumption of this plant. The conversion of dietary nitrogen to tissue nitrogen was quite small varying from 11 to 26 per cent on all the plants.

From the data wheat can be characterized as a good food plant while both oats and western wheat grass are poor. The evidence presented supports the view that oats is a poor food because a repellent, or the lack of an attractant, prevents enough of it being eaten, while western wheat grass is a poor food because it is nutritionally inadequate.

Microfilm \$2.00; Xerox \$3.00. 51 pages.



PORCUPINE POPULATION FLUCTUATIONS  
IN PAST CENTURIES REVEALED BY  
DENDROCHRONOLOGY

(L. C. Card No. Mic 59-810)

Donald Alexander Spencer, Ph.D.  
University of Colorado, 1958

Supervisor: Professor Hugo G. Rodeck

Several species of mammals in feeding on woody trees and shrubs leave characteristic wounds that can be identified many years later. The trees or shrubs in turn make characteristic growth responses to this injury that permit relatively exact timing of the feeding for the first few months, and thereafter the year is preserved in the annual growth rings for centuries. Three species of conifers and several shrubs on Mesa Verde in southwestern Colorado are "drought plants" having a similar distinctive internal pattern of narrow, normal and wide annual growth rings, formed in response to an area-wide climatic complex. The pioneering work of Drs. A. E. Douglas and Edmund Schulman have made dendrochronology of southwestern United States the best understood and most thoroughly studied of any area in the Western Hemisphere. No location could have been better suited for the initiation of studies to use this scientific technique to investigate the relative distribution and numbers of animals in past centuries.

Records on Mesa Verde National Park attest the fact that porcupines were overly abundant from 1930 to 1945, preceded by a period of relative scarcity. Since 1945, this porcupine population has gradually subsided without benefit of artificial controls. This regression was carefully followed from 1946 to 1958, using such field techniques as capture-mark-release, to follow animal movements; night road patrols during the autumn, both to mark animals and to provide an index of population levels; enumeration of timber damage pockets as related to available habitat as a census method; and lastly, broad timber damage surveys. The picture of the last population surge of porcupines is, therefore, a matter of direct observation.

The position of a scar in pinon pine (*Pinus edulis*), its shape and its replication, together permit positive identification of porcupine feeding many years after all signs of tooth marks have weathered away. At the perimeter of the scar is a narrow margin that has been protected against modification of the ring record by in-rolling of new wood. Several thousand samples for dating were collected on the one hundred square mile eastern half of Mesa Verde using increment drill and cross-cut saw. Under the laboratory microscope the internal ring pattern permits accurate dating of trees or wood surfaces long dead.

Collections from single over-age pinons that have withstood repeated porcupine feeding, or from isolated groves of trees each member of which was sampled to obtain an occupancy record, or from linear strip collections spotted throughout the mesa, all repeat the same information. From about 1835, to the present, there have been four surges in the porcupine population on Mesa Verde with intervening periods of ten to fifteen years of relative scarcity. The population curve is pyramidal in form. Three of the irruptions cover periods approximately twenty years in length, 1835-53, 1867-91, and 1924-45. The fourth, of minor intensity, lasted approximately twelve years, from 1898-1910. The peak in the 1880's was at least equal in

intensity to that in the 1930's based on the ratio of scars now present to timber stand survival.

Feeding pressures on slow-growing trees need not be constant to produce a suppressed and ragged timber stand. The porcupine on Mesa Verde is a major factor in maintaining a relatively young age classification in the forest cover. Nonetheless, the pinon stand persists, providing truly remarkable examples of compression wood and injury recovery mechanisms.

Microfilm \$2.00; Xerox \$6.00. 122 pages.

STUDIES ON THE MORPHOLOGY AND  
DEVELOPMENT OF *MAZOCRAEOIDES*  
*OLENTANGIENSIS* N. SP. (TREMATODA: MONOGENEA),  
A PARASITE OF THE GIZZARD SHAD, *DOROSOMA*  
*CEPEDIANUM* (LE SUEUR)

(L. C. Card No. Mic 59-427)

Stanley Alexander Sroufe, Jr., Ph.D.  
The Ohio State University, 1958

*Mazocraeoides olentangiensis* n. sp. (Trematoda: Monogenea), a parasite of the gills of the gizzard shad, *Dorosoma cepedianum* (Le Sueur), has been described in detail. This trematode, a member of the family Mazocraeidae, was found on the gills of 112 of 164 (68.2 percent) of the fish host. *M. olentangiensis* is similar to other members of the genus in that the shape of the body is clavate and the anterior pair of clamps is near the middle of the body. The clamp structure of this species is similar to and homologous with that described by Llewellyn for *Kuhniascombri* (Kuhn, 1829) Sproston, 1945. The genital corona is armed with five longitudinally arranged, S-shaped hooklets and two larger lateral hooklets. The ovary is looped, consisting of a descending and an ascending limb, whereas the testis is saccate and located lateral to the ovary. As in other members of *Mazocraeoides* the vaginal pore is located mid-dorsally. Its duct extends posteriorly in the midline, then laterally, and joins the left (or right in some specimens) vitelline duct; as a result, the vitelline reservoir acts as a seminal receptacle.

In addition to the growth of the body and assumption of the definitive shape, development in this species is characterized by loss of certain larval structures, the metamorphosis and growth of other larval parts, and also the formation of new ones. The development of *M. olentangiensis* has been divided into a series of stages. The stages have been designated as follows:

First-stage larva - the oncomiracidium.

Second-stage larva - the stage following the shedding of the ciliated covering of the oncomiracidium.

Third-stage larva - the stage initiated by loss of the fourth (posterior) pair of lateral larval hooklets and the formation of the fourth (posterior) pair of clamps.

Fourth-stage larva - the stage characterized by the loss of the third pair of hooklets and the formation of the third pair of clamps.

Fifth-stage larva - the stage characterized by the loss of the second pair of hooklets and formation of the second pair of clamps.

Sixth-stage larva - the stage characterized by loss of the first pair of hooklets and the formation of the first pair of clamps.



Juvenile stage - the stage immediately preceding the formation of ova, sperm, and mature vitelline cells. This stage terminates with the appearance of fertile ova.

Adult - the stage characterized by formation of fertile ova. Microfilm \$2.00; Xerox \$4.20. 78 pages.

**A STUDY OF RELATIONSHIPS BETWEEN THE  
CONFUSED FLOUR BEETLE (*TRIBOLIUM CONFUSUM*  
DUVAL) AND ASSOCIATED MICROORGANISMS  
IN FLOUR AND WHEAT**

(L. C. Card No. Mic 59-1306)

Jesse Huggett van Wyk, Ph.D.  
University of Minnesota, 1958

All the stages of *Tribolium confusum* except the surface-disinfected eggs and some of the living adults carry on and inside their bodies spores of the common storage molds. Great numbers of bacteria were found in larvae and adults. The number of bacteria inside the adults and larvae was far greater than the number of bacteria in the food from which these stages were taken. The presence of these bacteria in autoclaved whole wheat flour had a marked effect on the growth and reproduction of the insect, while the presence of storage molds in the same medium did not show such marked effects. Addition of bacteria, obtained from the insects, to the autoclaved flour improved growth of larvae and egg production over that of insects fed on autoclaved flour alone. On a vitamin-free diet the presence of these bacteria allowed normal growth and development of the larvae.

With the aid of an olfactometer, as well as the use of a multiple choice apparatus, beetles were tested to see whether they would be attracted to flour containing microorganisms. These tests showed that the movement of the insects was greater in response to odor from flour plus storage molds (more intense), or from flour plus bacteria (less intense), than to odor from autoclaved flour alone.

The activity of *Tribolium confusum* in flour or wheat was always accompanied with a decrease in storage mold counts. On the other hand, bacterial counts increased whenever the beetles were present, and the increase was roughly proportional to increasing time and greater at higher relative humidities. When *Tribolium confusum* and *Sitophilus oryzae* were cultured together in whole wheat grain, however, both fungi and bacteria increased moderately over a period of 1 month, and very extensively over a period of 2-3 months. Evidently, the effect of *Sitophilus* in increasing the storage molds and the inability of *Tribolium* to reproduce in whole wheat of low moisture content, more than offset the tendency of the latter to reduce the mold population.

The presence of storage molds in whole wheat at low moisture contents appeared to favor the survival of *T. confusum* beetles. After 3 months all the beetles were dead in the non-moldy wheat, while some of the beetles were still alive in the moldy wheat.

Quinone extracts from *Tribolium confusum* were very toxic to storage molds and bacteria isolated from flour, from wheat, and from the same insect, when mixed with the flour or grain containing these microorganisms, or in a closed space, or in a water-agar suspension. Gasses

given off by these beetles, tested in the same way, were less toxic. Microfilm \$2.00; Xerox \$4.60. 87 pages.

**SEASONAL VARIATION IN THE ENERGY BALANCE  
OF THE TREE SPARROW IN RELATION  
TO MIGRATION**

(L. C. Card No. Mic 59-600)

George Curtiss West, Ph.D.  
University of Illinois, 1958

The annual cycle of physiological changes of the tree sparrow, *Spizella arborea*, is traced in order to determine if migration is necessary for the attainment of a favorable energy balance throughout the year.

Birds were captured during the winter in Illinois and trapped on their nests at tree-line near Churchill, Manitoba, during the summer, and energy balance studies were run under constant conditions and under naturally varying outdoor conditions. The calories lost in the excrement were subtracted from the gross energy intake to give metabolized energy which is the same as existence energy when birds maintain constant weight. A range of temperatures from -30° to +39.5°C were utilized for both winter-acclimated birds at 10-hours photoperiod and for non-breeding summer birds retained in Illinois at 15- and 19-hours photoperiod. Two temperatures, 8° and 32°C at 19 hours were used for breeding birds at Churchill.

Under constant experimental conditions, an increase or decrease of temperature from 35°C results in a reduction of body weight due to the loss of fat, contrary to wild birds that show a weight and fat peak in the winter. Heavier birds metabolize more energy than lighter birds except at high temperatures.

Gross energy intake and energy metabolized per day increases linearly with decreasing temperature with no significant differences among photoperiods. However, the hourly rate of food intake at a given temperature is progressively less at longer photoperiods. There is no significant difference between the sexes with regards to metabolized energy.

Although the caloric value per gram of excrement does not vary significantly with photoperiod or temperature, the amount of energy lost in the excrement increases linearly with decreasing temperature due to a greater volume of food digested at low temperatures. More energy is lost in the excrement per hour on short photoperiods correlated with the increased hourly rate of food intake.

The efficiency of food utilization increases with temperature at all photoperiods. However, winter birds at 10 hours are less efficient than summer birds at 15 or 19 hours since digestion is more rapid.

Constant air temperatures above 35°C causes increased production of keratin in bills and claws of tree sparrows. Metabolism is decreased above 30°C with no rate of change indicated between 35° and 39.5°C.

Energy metabolism of control birds under fluctuating outdoor temperatures in Illinois increases significantly with decreasing temperature, but at a slower rate than under constant conditions.

Non-molting birds at Churchill have 25 percent lighter plumages than in the winter in Illinois. Birds retained in



Illinois during the summer lose only 6 percent of their winter plumage. Therefore, Churchill birds at both constant and fluctuating temperatures had a higher metabolic rate than Illinois birds due to decreased feather insulation and onset of fall molt at the time of the experiments in July and August. Short term acclimation to low or high constant temperatures by altering plumage density does not occur in the tree sparrow.

The maximum amount of metabolized energy per day, occurring at the lowest tolerated temperature ( $-28^{\circ}\text{C}$ ), is the same at all seasons (28.78 Cal/bird/day).

Energy required for existence is greatest during January in Illinois, least in July at Churchill. If birds remained in Illinois during the summer, their existence energy requirements would be 23 percent less than at Churchill. However, the hourly rate at which existence energy must be accumulated would be the same during the summer for birds at both Churchill and Illinois.

The comparison of energy requirements for incubation indicates that Churchill birds require more energy per day than if they remained in Illinois, due to the differences in mean summer temperature. However, the hourly rate at which the energy must be accumulated would be the same in both latitudes.

The tree sparrow does not gain a more favorable energy balance by migrating north each spring. Its daily energy requirements are greater, but because of the longer days, the hourly rate of energy accumulation remains about the same. Factors other than energy relations are undoubtedly responsible for this species' northward migration.

Microfilm \$2.00; Xerox \$3.80. 70 pages.

STUDIES OF MORPHOGENESIS IN  
EUPLOTES EURYSTOMUS WRZESNIEWSKI.  
I. THE EFFECTS OF ULTRA-VIOLET (2537Å)  
ON DIVISION, REGENERATION, AND REPAIR

(L. C. Card No. Mic 58-5195)

Francis Wagoner Yow, Ph.D.  
Emory University, 1958

*Euplotes eurystomus* Wrzesniewski was cultured on a bacterial medium containing *Aerobacter aerogenes* and *Tetrahymena pyriformis* and on a non-bacterial medium containing *T. pyriformis* alone. Animals on both of these media, as well as animals which had not been fed particulate food for 12 hours, were injured with two operations, one of which removed some of the locomotor organelles and one which did not disturb these structures, using the Chambers micromanipulator. Subsequent to these injuries, animals were exposed to ultraviolet radiation of 2537Å wave length, in doses ranging from 10,000 to 15,000 ergs/mm<sup>2</sup> in 500 ergs/mm<sup>2</sup> intervals.

Following exposure to ultraviolet in the above range,

there is a delay in division, in regeneration after removal of locomotor organelles, and in repair following injury not damaging to these structures. This delay increases as the total dose of ultraviolet increases, until, at a critical dose, each of the three morphogenetic processes is completely inhibited.

*Euplotes* in various experimental groups were exposed to visible light preceding, concurrently, and following the ultraviolet radiation to determine the presence and degree of photoreversal of delay in morphogenetic events induced by ultraviolet. Treatment with visible light prior to ultraviolet radiation has no detectable effect upon the ultraviolet induced delay. However, treatment with visible light concurrently, or immediately after ultraviolet radiation decreases by about one-third (at the lower doses used) the amount of delay produced by the ultraviolet. At the higher doses of ultraviolet used, treatment in the same fashion as before with visible light restores the potential for reorganization in the macronucleus, but not in the cytoplasmic structures.

The suggestion is made that since higher doses of ultraviolet are necessary to inhibit repair than those required to inhibit regeneration, that this is due to a greater sensitivity of the macronucleus than the cytoplasm. From this it would seem that nuclear reorganization is a requisite for cytoplasmic reorganization. It is further believed that the restoration of nuclear reorganization potential without cytoplasmic restoration is due to repair of damage caused by ultraviolet in nucleic acids, but not in damaged nucleoproteal synthesis of the infraciliature. That the kinetosomes have a greater sensitivity than the cortical network is evidenced by a greater delay and a lower critical dose in regeneration, even when nuclear reorganization occurs, than in repair.

Animals which had been fed *Tetrahymena* and *Aerobacter* prior to microdissection and radiation demonstrated a trend toward greater sensitivity to ultraviolet, as determined by the amount of morphogenetic delay, than those fed on *Tetrahymena* alone, while those in the latter group were not as resistant as those which had not been fed particulate food for 12 hours. The suggestion is made that this difference in sensitivity is due to the partly metabolized nucleic acids of the food organisms releasing toxic materials into the cytoplasm of *Euplotes* upon radiation with ultraviolet of 2537Å. These may be absent in the unfed group, and might differ in the other two groups, depending upon the source of the nucleic acids.

Suggestions are made for experiments to verify the presence of these toxic materials, and to determine whether or not different sources, other than those used would yield different results. Other experiments are proposed, using ultraviolet radiation of different wave lengths, such as those shorter than 2500Å which would only affect surface structures. In addition, localized radiation, such as the ultraviolet microbeam, could be used to determine the site of injury in morphogenetic inhibition. The latter tool is suggested for use in analyzing the development of cirral fields.

Microfilm \$2.00; Xerox \$3.80. 68 pages.



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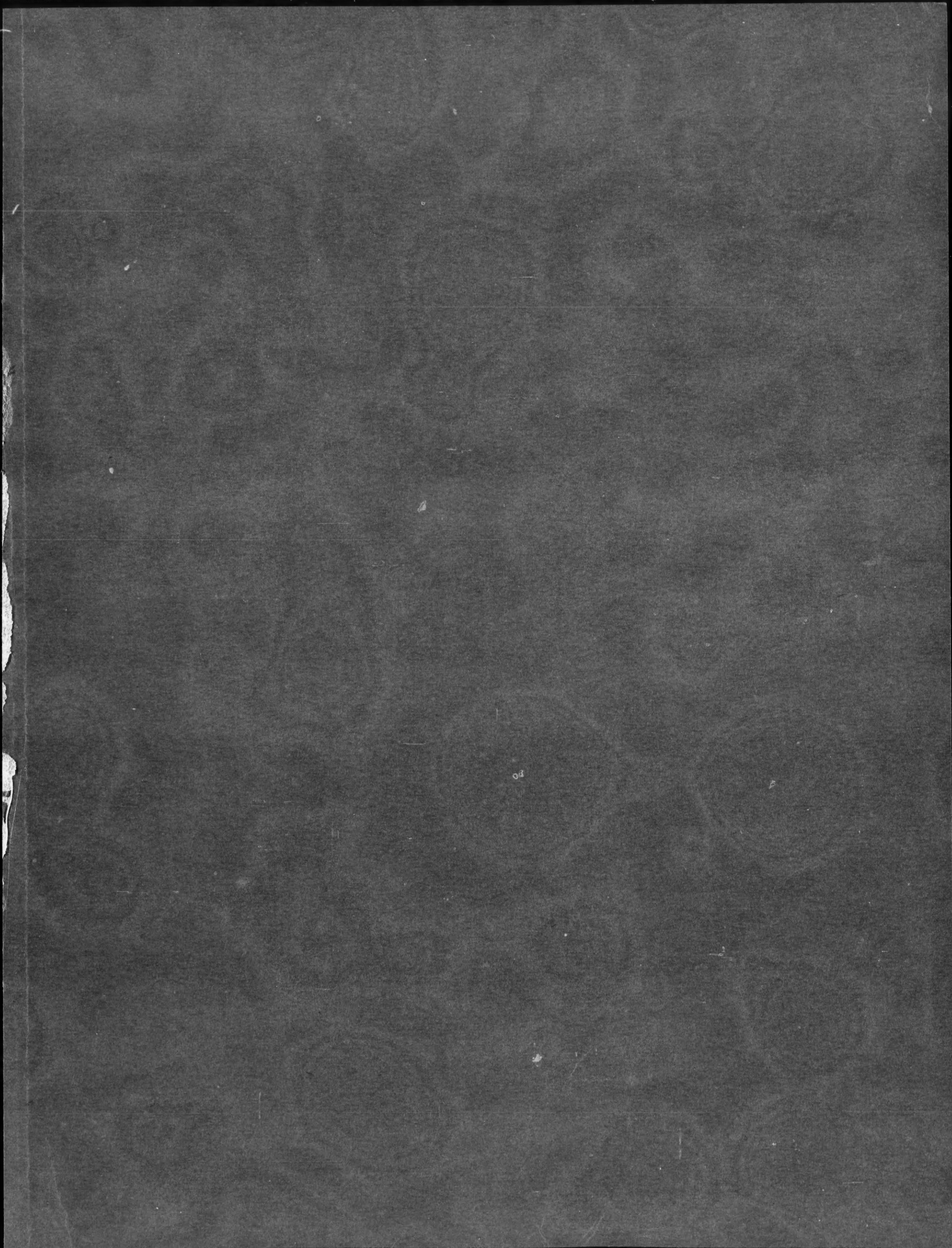
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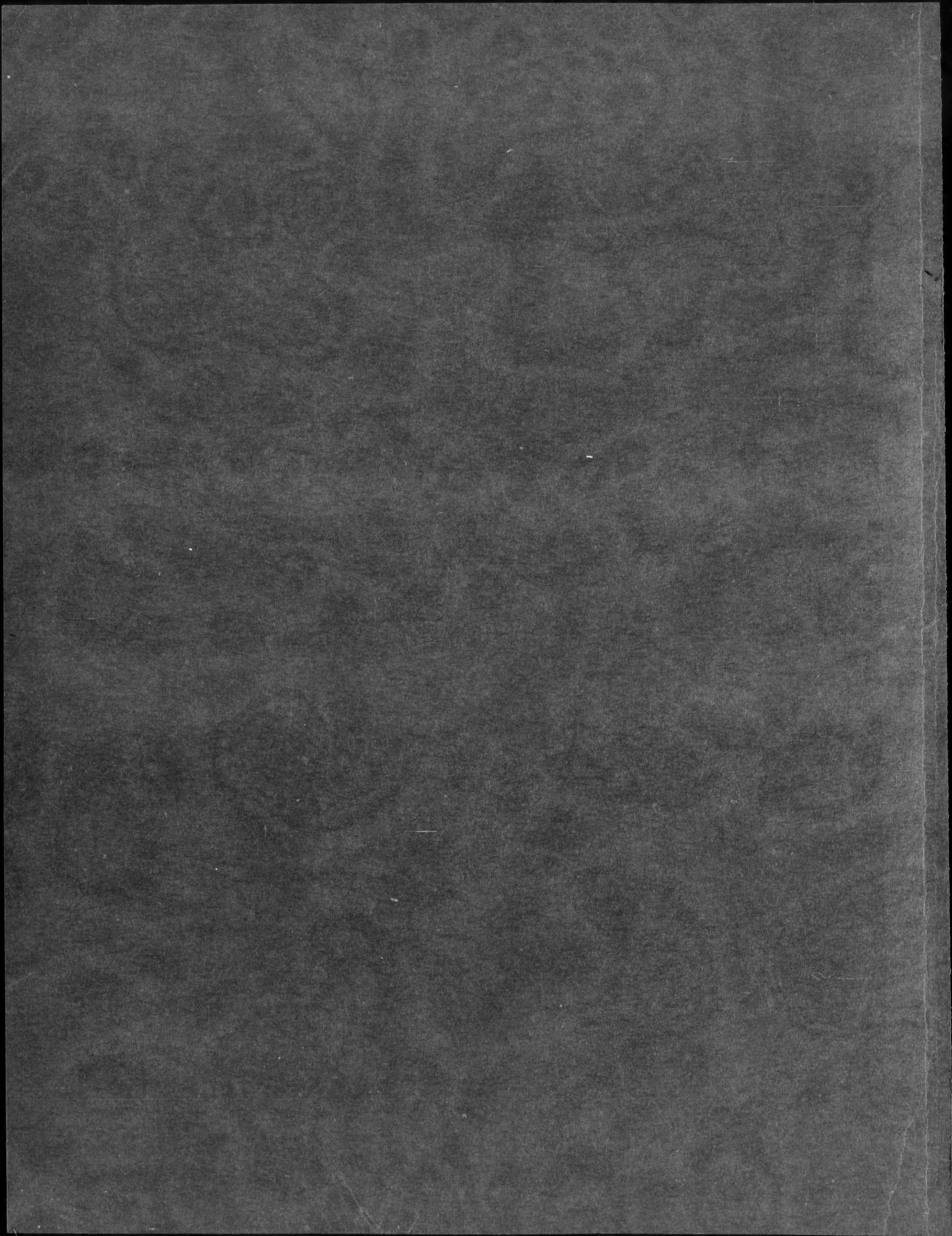
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